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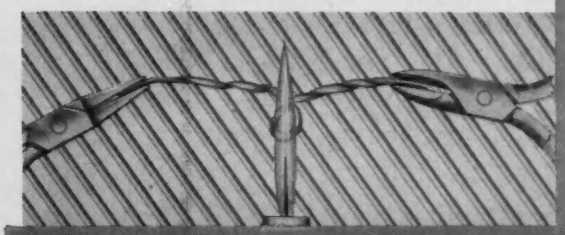

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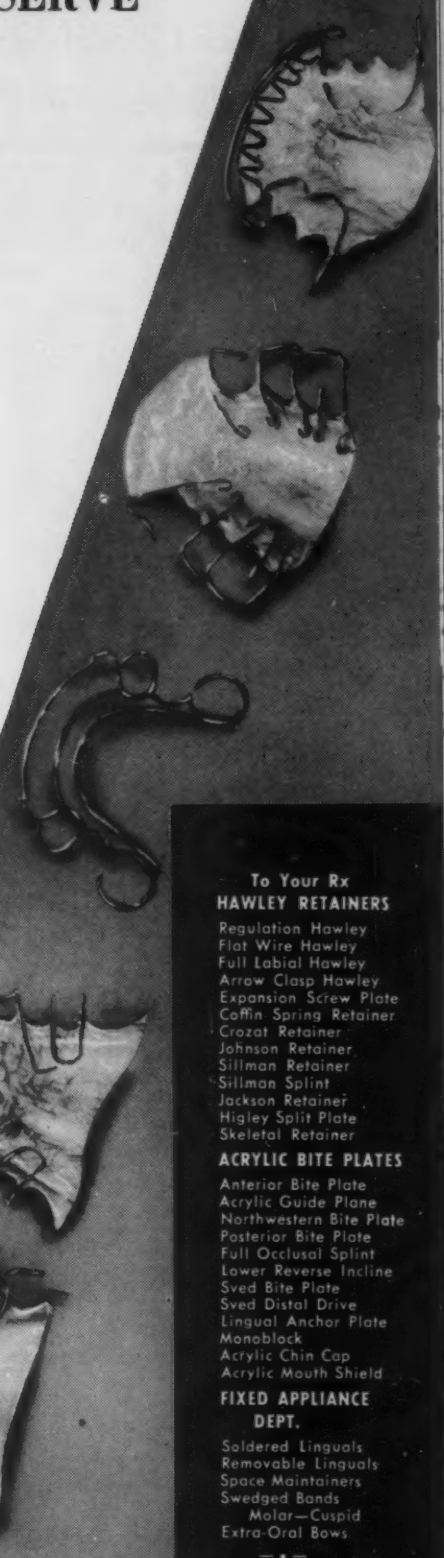

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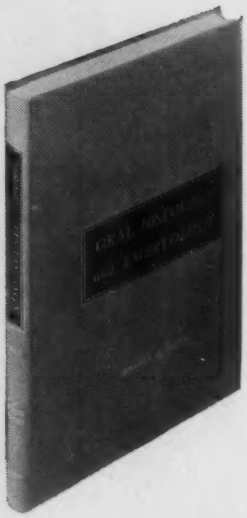

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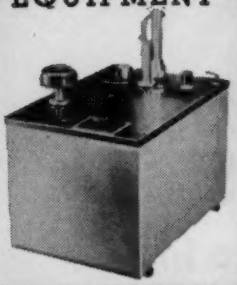

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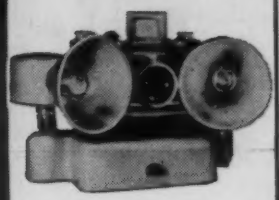

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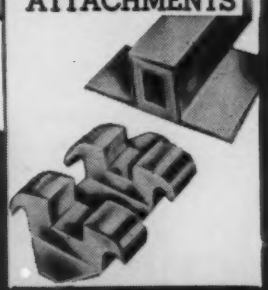

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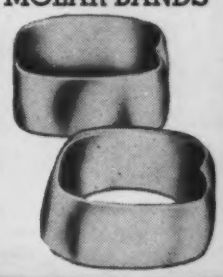

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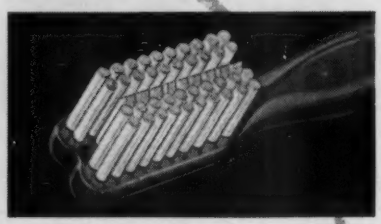

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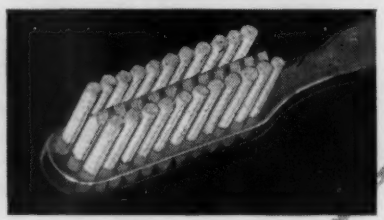

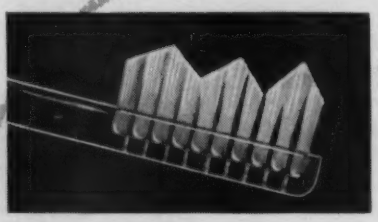

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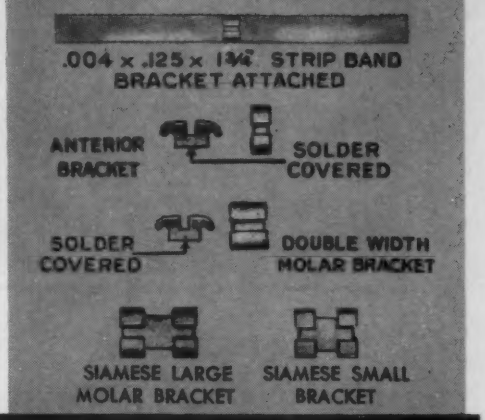

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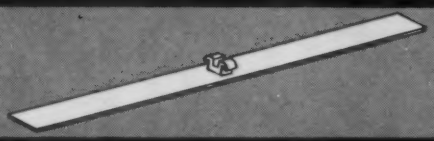

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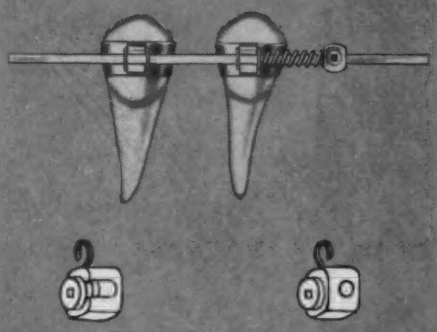

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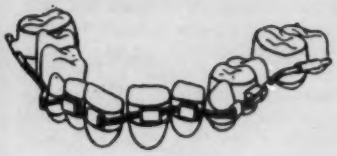

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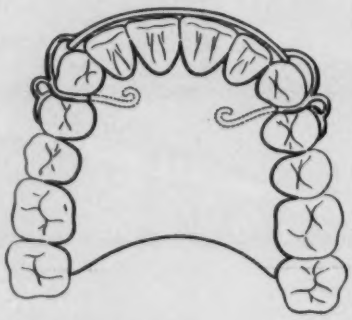

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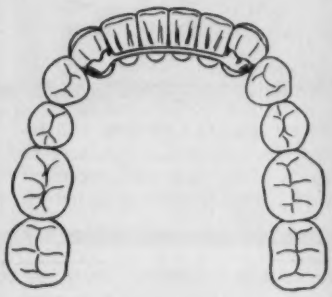

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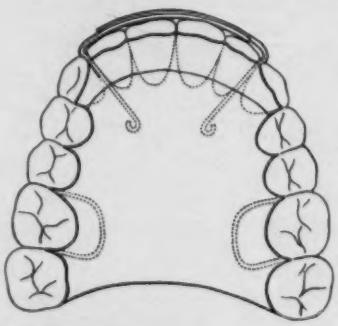

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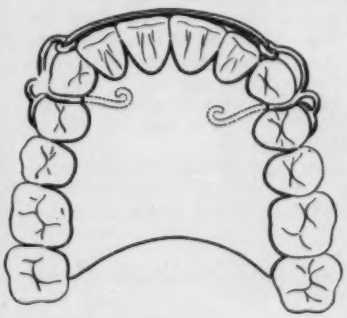

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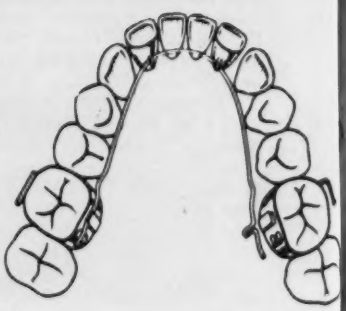

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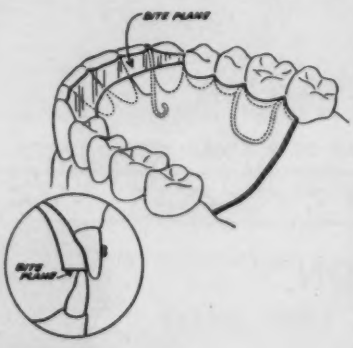

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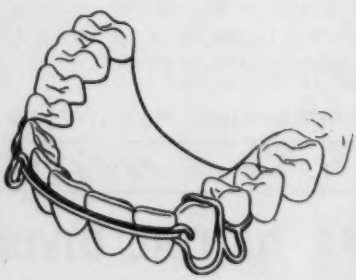

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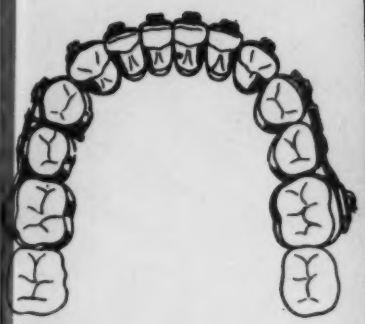

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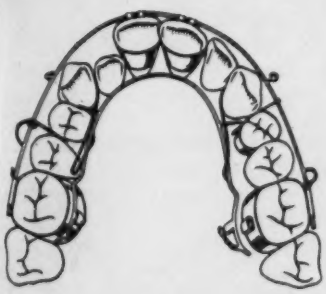

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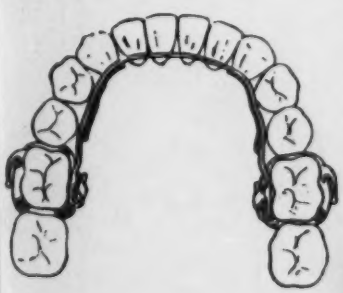

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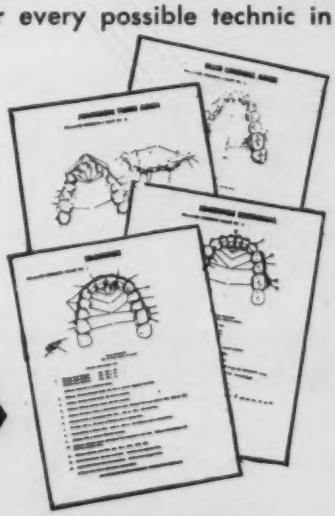

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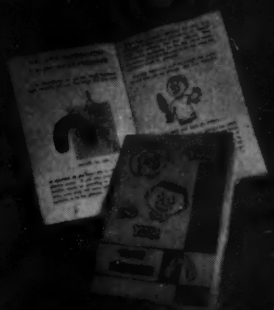

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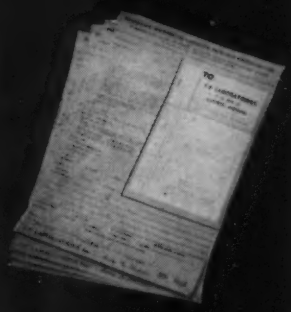

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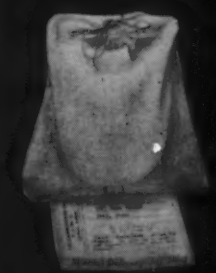

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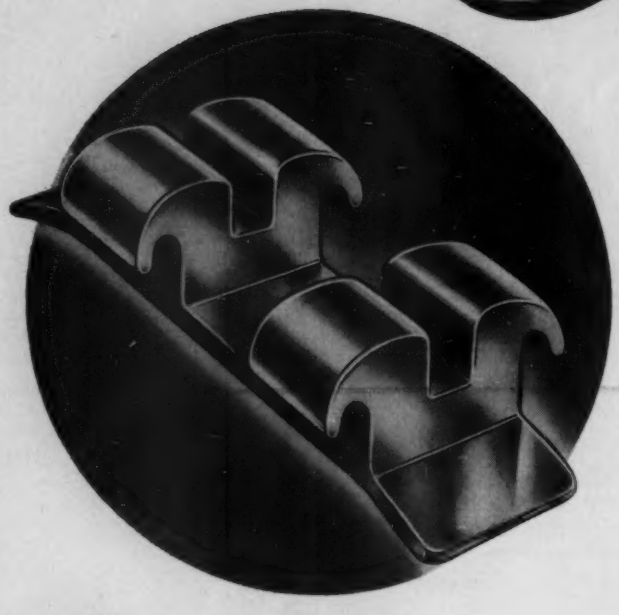

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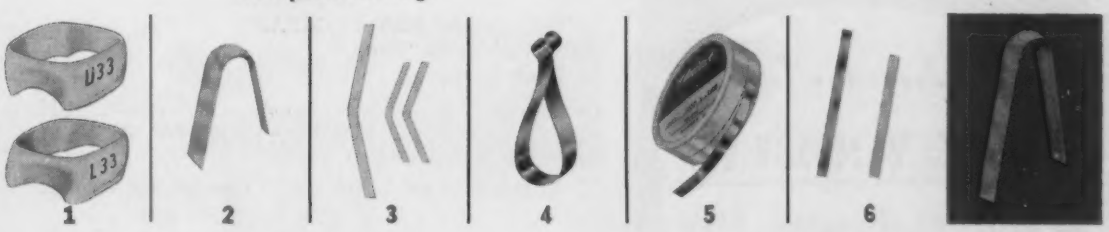

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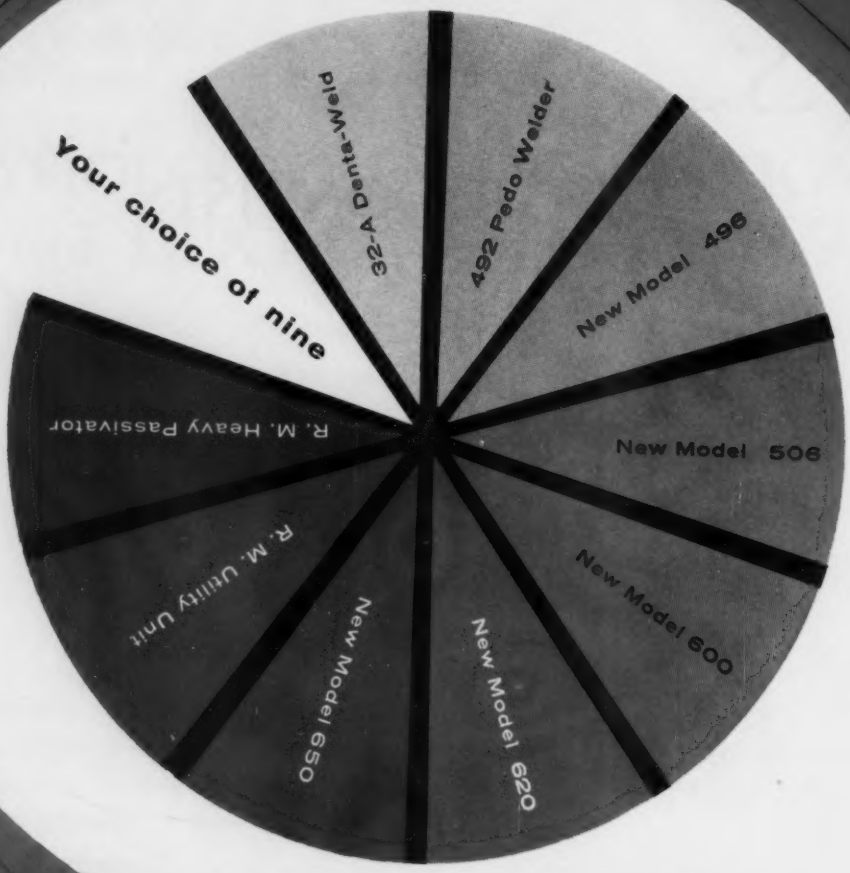

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Original Articles

MATTERS PERTAINING TO THE TWEED TEACHINGS IN ORTHODONTICS AND THE TREATMENT OF BIMAXILLARY PROTRUSIONS ACCORDING TO THOSE TEACHINGS

B. L. HERZBERG, D.D.S., M.D.S., CHICAGO, ILL.

PART I

MUCH has been written concerning the work of Charles H. Tweed, and the literature is replete with both his philosophy and the treatment advocated by him. I have had published some five papers based on these teachings and having to do with facial esthetics, diagnosis, and treatment.[1-5] It would seem, therefore, that there is little need to elaborate upon the general theme except to point out that, as originally conceived and previously written about, there have been marked changes in the matter of diagnosis and treatment, with the basic concept or philosophy remaining the same. In addition, the great interest shown by the profession in attempting to acquire information concerning the teachings of Tweed and also the feeling of many orthodontists that the following of his teachings tends toward better orthodontics for the patient are excuse enough for attempting to bring to the profession the current teachings of Tweed.

This discussion, then, will reiterate the basic philosophy and will include the current methods of making the diagnosis and carrying through the mechanical therapy. Because of limitations, however, it will include only the treatment of a bimaxillary protrusion extraction case. It will also give examples of

Presented before the Great Lakes Society of Orthodontists, Detroit, Michigan, Oct. 21, 1957.

results attained by me, and probably by many others, before the adoption of Tweed's concepts and teachings and subsequently the results obtained following adoption of those teachings.

In speaking of the Tweed philosophy, probably the most salient point made is that teeth in normal occlusion (that is, teeth well placed in relation to each other and to the basal bones) have as one of their concomitant factors a face that is considered in esthetic balance. Along with this, the mandibular incisor teeth are relatively upright to the mandibular base plane, and their position has been described by Tweed as being 0 ± 5.[6] Subsequent work on this particular aspect of position of the lower incisors, done by Margolis and others, has placed the mandibular incisor at relatively 90 degrees to the mandibular base.[7] Thus, the ± 5 has become 90 degrees for the upright position of the lower incisors, with from 85 to 95 degrees as the relative normal range. Along with this, Tweed called attention to the Frankfort-mandibular plane angle, that angle formed by the Frankfort horizontal plane and the mandibular base plane.[8] He felt that this angle, as a mean, had a value of 25 degrees and that the normal range was from 20 to 30 degrees. Thus, the thesis was developed that for an upright mandibular incisor at 90 degrees the Frankfort-mandibular plane angle would be 25 degrees and that with the anterior tipping of the lower incisors at 95 degrees there could be excellent facial esthetics with a Frankfort-mandibular plane angle of 20 degrees and, conversely, with the lingual tipping of the lower incisors to the mandibular base of 85 degrees there could be excellent facial esthetics with a Frankfort-mandibular plane angle of 30 degrees. For some time, then, the measurement of these angles (that is, the incisal-mandibular angle and the Frankfort-mandibular angle) was considered an important factor in the diagnosis of orthodontic cases, and deviations, in a general way, from the normal range of variability of these two angles were considered, along with other factors, as bases for diagnosis.

Some time later, in the fall of 1952, Tweed published an article bringing to the attention of the orthodontist still another angle, namely, the Frankfort-mandibular incisor angle.[9] This angle, formed by the plane drawn through the long axis of the mandibular central incisor tooth and the Frankfort horizontal plane, was used by Tweed to elaborate further upon the role of the position of the mandibular incisors in facial esthetics. This whole concept was based upon a study that Tweed made of the faces that he encountered in everyday life, relative to facial esthetics as they appealed to him. In this study, which took into account over 100 persons, Tweed found that the well-balanced face need not necessarily have lower incisors that were within the ± 5 range. He found specifically, for example, that where large Frankfort-mandibular plane angles were encountered in these esthetically pleasing faces, the lower incisors were tipped lingually to the extent that the Frankfort-mandibular incisor angle approached 65 degrees or greater.[10, 11] Thus, there were esthetically pleasing cases on record in which the lower incisors were at 69 degrees to the mandibular base. Even though the Frankfort-mandibular plane angle in one case was 36 degrees, facial esthetics was good with the Frankfort-mandibular

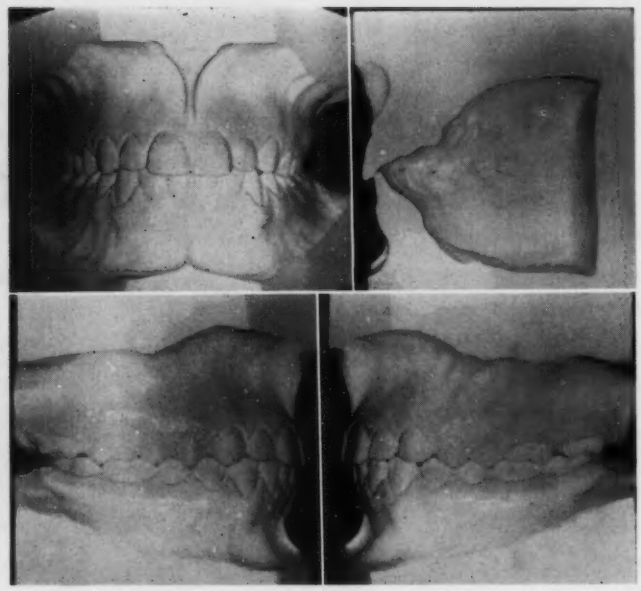
incisor angle of 65 degrees. From this extreme in both the position of the lower incisors lingually and the large Frankfort-mandibular plane angle to the smaller Frankfort-mandibular plane angles and the more upright mandibular incisor to mandibular base, as long as the Frankfort-mandibular incisor angle was 65 degrees or larger, facial esthetics was ordinarily good to excellent. Occasionally, an exception to this general pattern was noted, and in such instances the Frankfort-mandibular incisor angle might be slightly below 65 degrees and facial esthetics might still be good to excellent. The infrequency with which this exception occurred did not, however, alter the general observation or premise. Thus, Tweed evolved what some call the Tweed triangle, formed by the mandibular base line, the Frankfort horizontal, and a line drawn through the long axis of the mandibular central incisor. For the mean, the readings of the various angles formed by this triangle were 25 degrees for the Frankfort-mandibular, 90 degrees for the incisor-mandibular, and 65 degrees for the Frankfort-mandibular incisor angle. Tweed has come to think that an angle even greater than 65 degrees for the Frankfort-mandibular incisor angle enhances facial esthetics even more in a great many cases. Having gone this far and thinking of orthodontic treatment, Tweed then stated that, for every degree over 25 in the Frankfort-mandibular angle, the mandibular incisor should be uprighted lingually 1 degree from 90 in the incisor mandibular angle, thus constantly aiming at a Frankfort-mandibular incisor angle of 65 degrees or better for the purpose of developing the best in facial esthetics for the patient. To attempt to describe graphically the face that Tweed considered esthetically acceptable, it was felt that subnasion (the junction of the upper lip and the nose) in the midline, the lips, and chin point should be on a relatively vertical plane to the Frankfort horizontal.

Now his philosophy also entered the field of treatment, basically pointed toward the establishment of lower incisors that were relatively upright to mandibular base. The general device used for attaining such results was the development of mandibular anchorage by means of Class III mechanics and tip-back bends; to stabilize, in so far as possible, the buccal segments in the mandibular arch as space closures were executed in the incisal segments, including the cuspids, in a distal or lingual direction; and then to stabilize all of the mandibular teeth as they were being used to make mesiodistal adjustments by means of Class II mechanics. In pursuit of all of Tweed's writings, in personal conversations, and in assisting in the courses given by Dr. Tweed under the auspices of the Charles H. Tweed Foundation for Orthodontic Research, I saw no specific or conscious effort made by Tweed to use expansion except in cross-bite cases.

It would seem that, logically, no diagnostic considerations could ever be undertaken without an appreciation of the normal. While there is no question that orthodontists understand a tooth relationship adjusted by cuspal interdigitation, mandibular to maxillary teeth, and proximal contact relationships tooth-to-tooth in the same arch, there may be some question as to whether an understanding of the relationship of the esthetically pleasing face to these

teeth exists. For these reasons, to clarify the basis from which we start, illustrations are included to show the right, left, and anterior views of casts of teeth in normal occlusion and, along with these, the facial illustration of the patient for whom the casts were made (Fig. 1). In the casts, not only is the

A.



B.

Fig. 1.—Representing the normal. The face shows the chin, the lips, and the junction of the upper lip with the nose as being on about the same vertical line that would be drawn at right angles to the Frankfort horizontal plane. There are practically no lip protrusion and no chin retrusion in this picture. The denture on the right and left sides exhibits a meshing and interdigitation of cusps that is considered normal, and the anterior cast shows the upper and lower midlines to be relatively exact. The overbite is not excessive, and the overjet is very slight. The cross section shows the lower incisor relatively upright to base.

classical relationship of the mesiobuccal cusp of the upper first molar occluded with, buccal to, and between the two principal buccal cusps of the lower first molar shown, but the axial inclinations of all the teeth in both the mandibular and the maxillary arches are relatively upright, at least to the extent that the

maxillary cuspid lies buccal to and directly between the mandibular cuspid and the first premolar. The upper and lower midlines are relatively exact. As for the facial illustration, in the profile view the subnasion, the lips, and the chin point in the midline are on a relatively vertical plane to the Frankfort horizontal.

It is not the purpose of this article to impose upon anyone either Tweed's or my own appreciation of facial esthetics. I can see nothing wrong in a difference of opinion regarding facial esthetics. Whatever one's appreciation of the best in facial esthetics might be, it behooves us, as orthodontists, to place ourselves in a position to obtain such improved facial esthetics by means of mechanotherapy and possibly through such therapy to control to some extent the growth tendencies. A tracing of an oriented lateral headplate of the person under consideration is used to illustrate the angular measurements in the triangle used for diagnostic purposes, and it is to be noted that the Frankfort-mandibular incisor angle is in the vicinity of the 65 degrees observed by Tweed (Fig. 2).

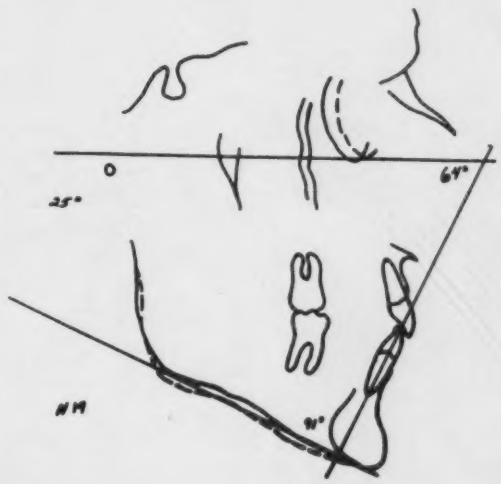


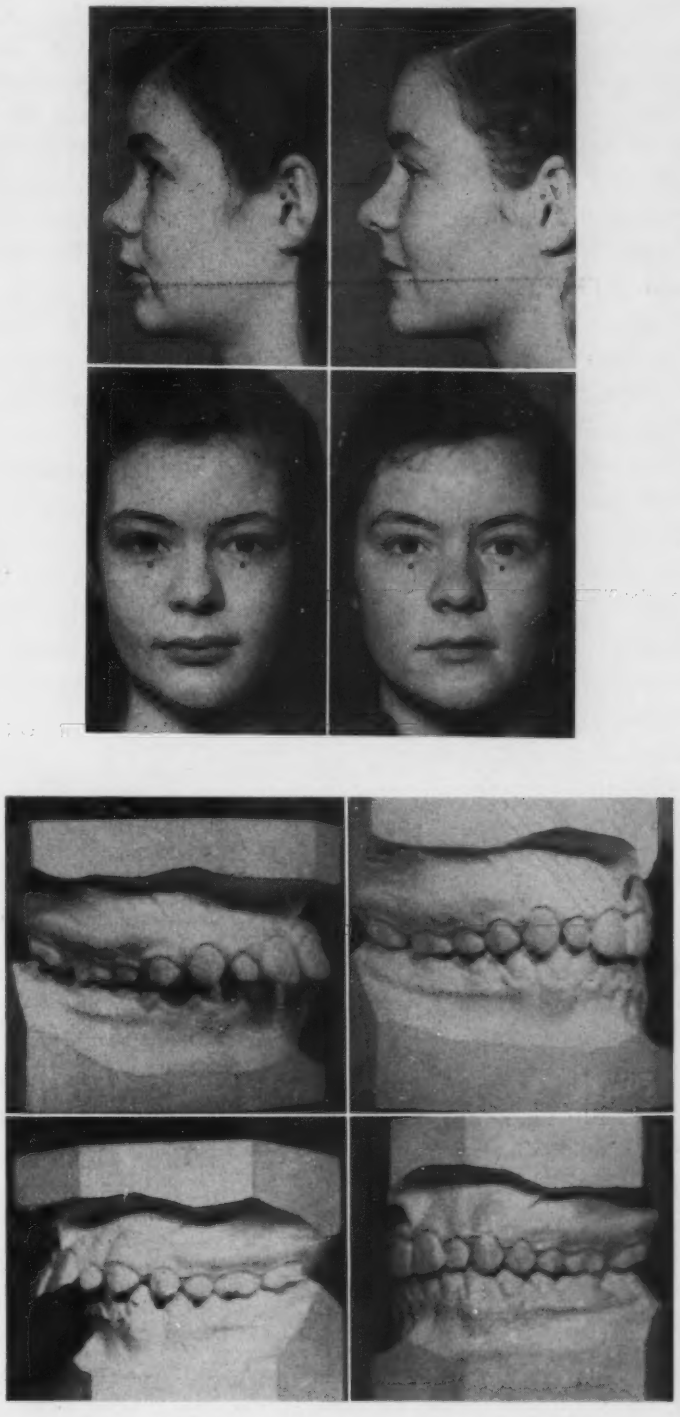
Fig. 2.—Oriented cephalometric tracing of a person well within the normal range. The Frankfort-mandibular angle is 25 degrees, the incisor-mandibular angle is 91 degrees, and the Frankfort-mandibular incisor angle is 64 degrees.

With the above information at hand, we are now in a position to use the devices for diagnostic purposes. The casts, of course, show us the malrelationship of occlusal positions of teeth, the oriented photographs point out to us lip protrusions and chin retrusions and protrusions, and the sagittal cephalogram gives us the various angular measurements that aid in determining the possibilities of uprighting incisors and other teeth to their respective bases and, at the same time, setting lower incisors lingually adequately to attain the best in facial esthetics. Contact breaks and rotations as indicated on the casts further show the possibility or lack of possibility of uprighting the mandibular teeth.

The diagnostic criteria are easily read. The process of making a diagnosis is relatively routine. If one will but check the few exceptions as they show

A. B. C.

Fig. 3.—Photographs showing treatment without extraction and with expansion. As shown by the before-treatment (left) and after-treatment (right) views, there has been no improvement in facial esthetics.



A.

Fig. 4.—Cases treated without expansion but, rather, with an effort to upright mandibular incisors to base. *A* shows a nonextraction case; all others are extraction cases.

(Continued on subsequent pages.)

up in the cephalograms against the oriented photographs, few pitfalls will be encountered. In this diagnostic procedure, as in all others, the difficulties will arise in the marginal cases. Is there or is there not the possibility of setting the teeth upright and lingually in the mandibular arch to attain the best in facial esthetics without the removal of teeth? That is the question that will arise and that eventually must be resolved. For those who have the sharpest visualization of the possibilities of uprighting teeth into spaces and the most acute mechanical therapy acumen, the diagnostic problems will be reduced.

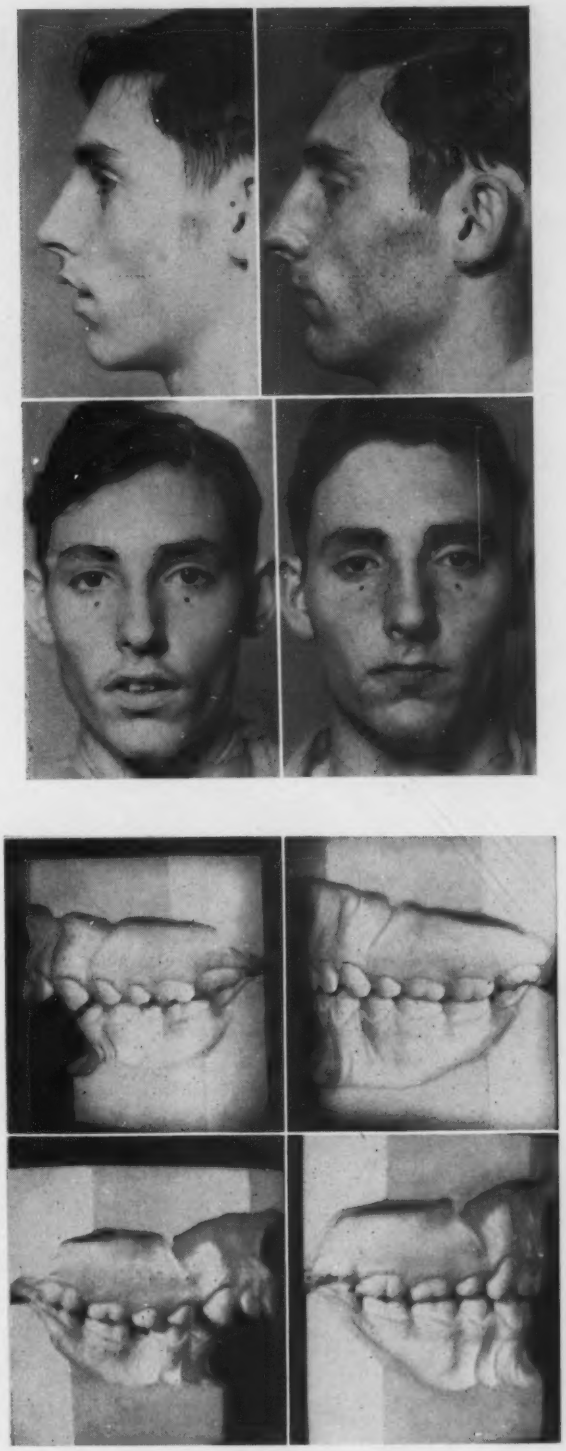
This would appear to be the time to discuss the matter of facial esthetics. For such purposes, the records in my office will be used. There will be displayed before you a series of cases treated prior to 1940, when expansion was used as the basis for treatment (Fig. 3). These photographs are shown for the purpose of exhibiting graphically what occurred to facial esthetics by the end of orthodontic treatment, when only tooth alignment and interdigitation were the prime considerations of treatment. Subsequently, there will be shown a series of photographs of patients treated after 1940, when the goal was not only the improvement of tooth alignment, tissue health, function, and stability but also the improvement of facial esthetics (Fig. 4). After studying this evidence, there can be no doubt that treatment according to the teachings of Tweed brings about much more pleasing facial esthetics, whether the results are attributed to orthodontic therapy, to growth changes in the patient during the process of treatment, to the control of those changes, or to all three. I have found that the patients like the esthetic changes much more than had previously been the case, and I feel convinced that the orthodontist himself is similarly impressed.

PART II

Part I of this article gave consideration to the basic thinking concerning the relationships of teeth as they would exist within the normal range of variability. The first part of the article also stressed the need for the development of anchorage or anchorage preparation to bring about, in orthodontic therapy, the correct positioning of teeth to mandibular base, predicated upon the normal range of variability.

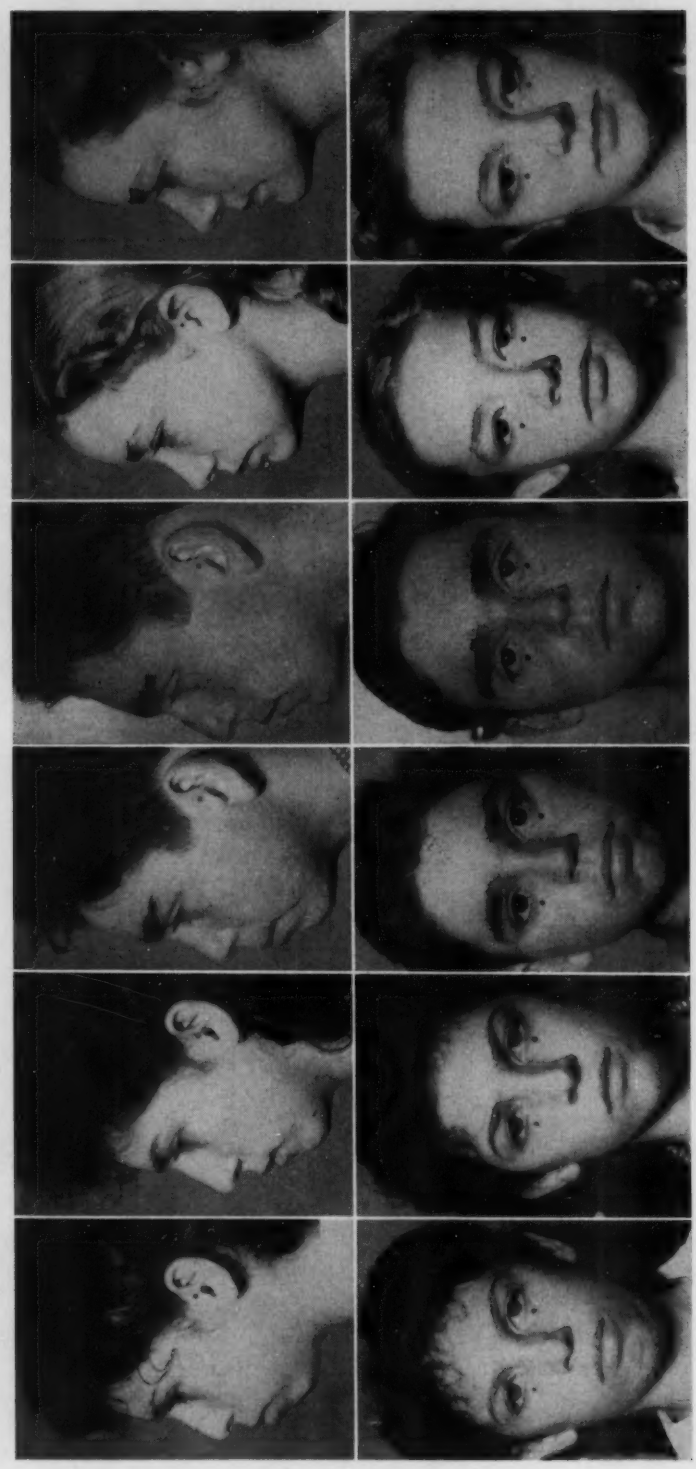
The development of anchorage has been stressed from time to time. Calvin Case[12] has gone so far as to recommend the banding of all teeth in buccal segments, soldering these bands together, and using this unit as anchorage to retract cuspids. So far as I know, no orthodontist prior to Tweed recommended the use of tip-backs and toehold in the mandibular or maxillary arches to develop anchorage preparation.

The need, of course, for such anchorage preparation stems from the need for uprighting incisor teeth over basal bone and the experiences of many that, if this anchorage preparation was not carefully carried through, the buccal segments might well move forward before the incisal segment and cuspids have been carried into the extraction site. Therefore, it can be reasoned that the



B.

Fig. 4 (Cont'd).—*(For legend, see page 733.)*



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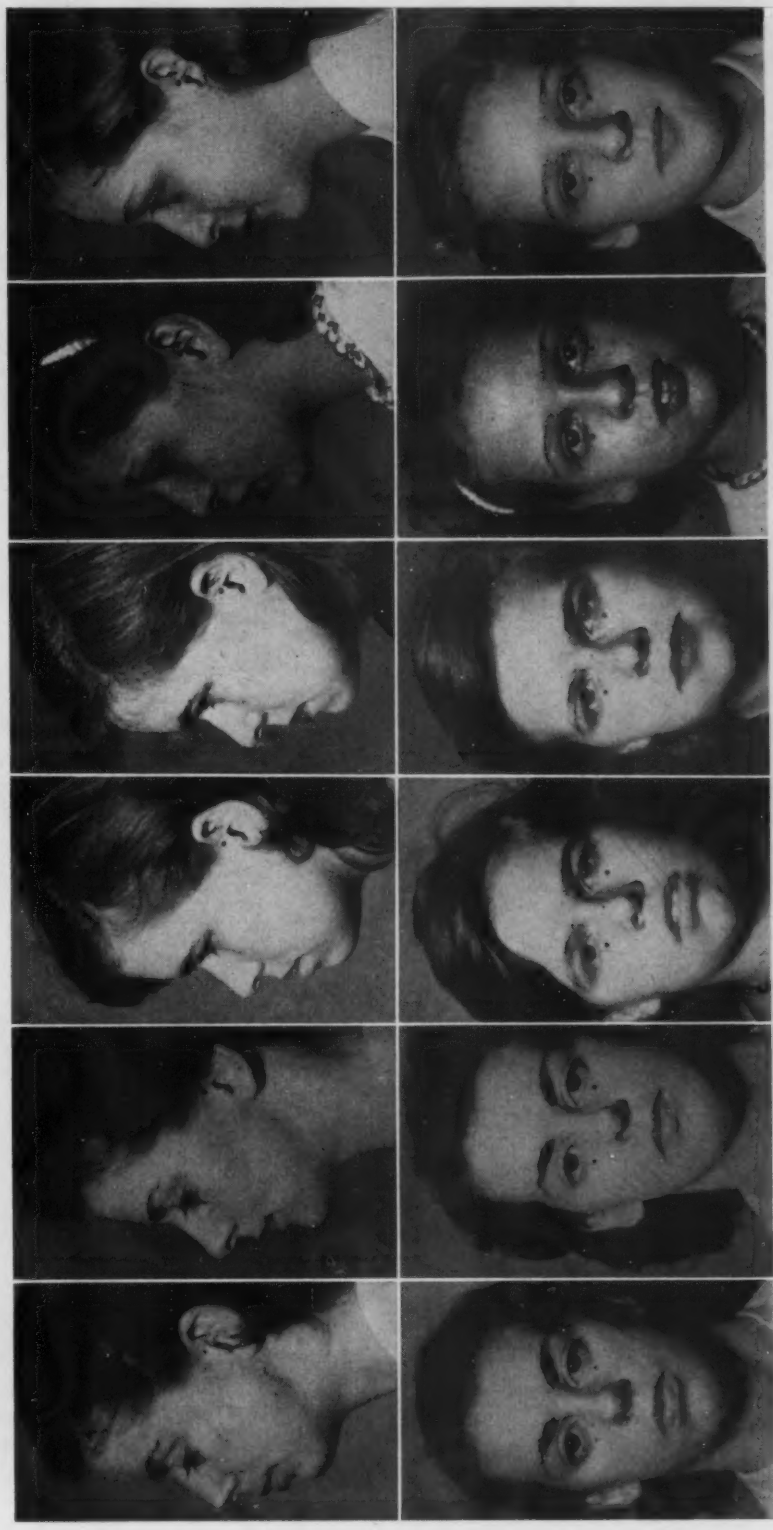


F. G. H.

Fig. 4 (Cont'd).—*(For legend, see page 733.)*

I. J.

K. L.

Fig. 4 (Cont'd).—*(For legend, see page 733.)*

Fig. 5.—Photographs and casts, before and after treatment, of a case similar to the type discussed in Part II of this article.

severity of the case determines the degree of anchorage preparation necessary. Tweed has stated that even with careful mechanics in the treatment of bimaxillary protrusion cases, it is to be expected that the forward migration of the buccal segments will consume one-third of the space at the site of the extractions. This portion of the discussion will be concerned with the treatment of a bimaxillary protrusion case assumed to require the greatest amount of lingual and distal positioning of the cuspids and incisors; in this case four first premolars are to be extracted.

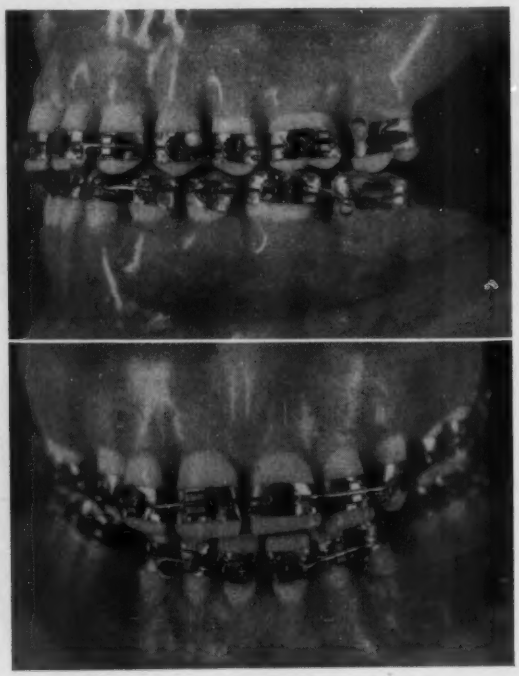


Fig. 6.—Edgewise bracket band assemblage.

There are two types of so-called bimaxillary protrusion cases: (1) those cases in which the teeth are in excellent or good alignment but are forward of basal bone and (2) those cases in which the teeth are crowded as well as situated forward to basal bone (Fig. 5). Both cases are handled in essentially the same manner. If the buccal teeth are upright, the requirement for anchorage preparation is not as great as if the buccal teeth are in mesial-axial inclination. In either event, however, the anchorage is prepared, frequently in the maxillary arch as well as in the mandibular arch. The steps in the mechanical therapy employed will now be given.

The four first premolars have been removed, for it is assumed that space on basal bone is inadequate to reposition teeth to their correct relationship to that bone and that space closure requires that a maximum of the extraction site be filled by the distal movement of the cuspids and the lingual movement of the incisors.

All teeth are banded, including the second molars (Fig. 6). If incisors are crowded, only the two most lingual incisors are banded, in both the maxillary and the mandibular arches if that is possible. All bands carry single-width edgewise brackets, except for the second molar bands which carry rectangular buccal tubes, the first molar bands which carry twin single brackets, and the upper central incisor bands which carry wide edgewise brackets. All bands except those on the molars carry mesial and distal staples on the labial or buccal aspect.

Treatment is divided into three stages: (1) mandibular anchorage preparation with Class III mechanics, (2) posterior en masse movement with Class II mechanics, and (3) artistic positioning of teeth before retention.

Ordinarily, the first arches placed are 0.018 inch in diameter, with stops incorporated to maintain arch length. These arches are kept in place in both the mandibular and the maxillary dentures for three weeks or longer in order to complete the leveling process. Mild tip-backs are placed in these 0.018 inch arches to begin uprighting the last molar teeth. Lighter round arches may be first used if required, then heavier round wires. During this stage, all rotations are corrected if possible.

These arches are replaced by rectangular arches, 0.021 by 0.027 inch, which are to be reduced in size where indicated. If the buccal teeth are upright and the cuspids are in mesial axial inclination and require uprighting, the above-mentioned rectangular arch is reduced to 0.020 by 0.026 inch, prior to which tip-backs in the buccal segments and tie-back loops slightly mesial to the buccal tubes have been incorporated. Horizontal loops are so soldered to these arches at the extraction site as to rest against the mesial aspect of the second premolars and are so formed that an eyelet soldered to the free end of the horizontal loop can be ligated to the distal staple on the cuspid band and can move and upright the cuspids between the buccal and lingual bony plates (Fig. 7). The arches are tied back to the distal aspect of the buccal tube or to a hook previously soldered to the mesiobuccal gingival aspect of the second molar bands. All four cuspids may be moved at the same time with Class III elastics from a hook at the gingival aspect of the lower arch just distal to the lateral incisor bracket and with extraoral anchorage in the maxillary arch engaging a hook on the incisal aspect just distal to the lateral incisor bracket (Fig. 8). This process is carried through until the cuspids are upright, and then these arches are discarded.

If, however, the teeth in the buccal segments are in mesial axial inclination, anchorage must first be prepared in both the mandibular and the maxillary arches. In this event, the maxillary arch is fashioned from 0.021 by 0.027 inch rectangular arch material, with stop loops incorporated in the arch to maintain arch length and with hooks to receive extraoral force as described previously. Mild tip-back bends are placed in the buccal segments of this arch. The mandibular or working arch is fashioned from 0.020 by 0.025 inch rectangular arch material with long tip-backs to allow the buccal teeth to upright and slide distally along the arch. There are no stop loops in this arch. This movement of the mandibular teeth is attained by the use of sliding jigs, which

are so fabricated as to engage the mesial aspect of the second premolar bracket at the distal portion of the jig and come forward of the cuspid bracket about 3 mm., with a hook formed at the mesial aspect of the sliding jig for the recep-

Fig. 7.

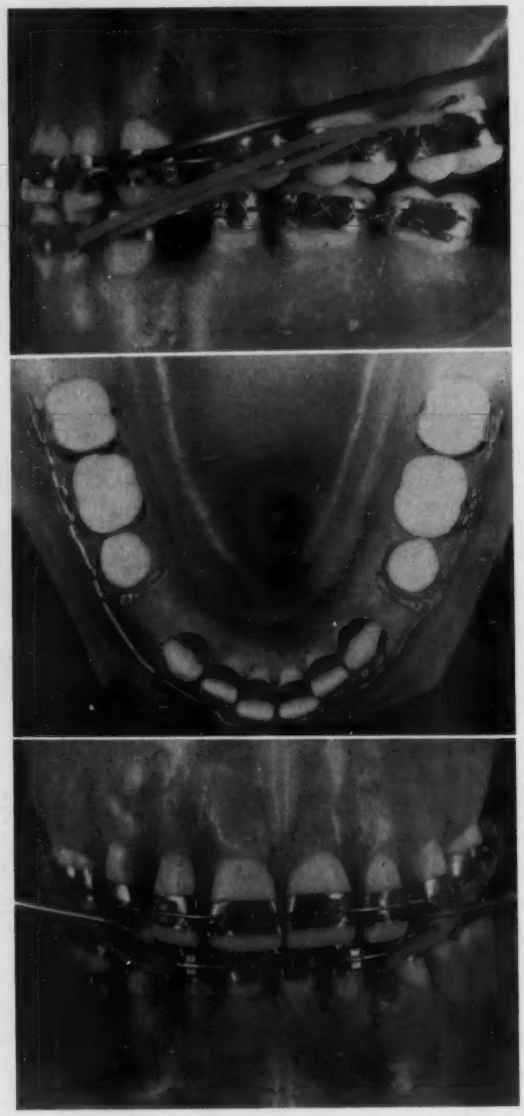


Fig. 8.

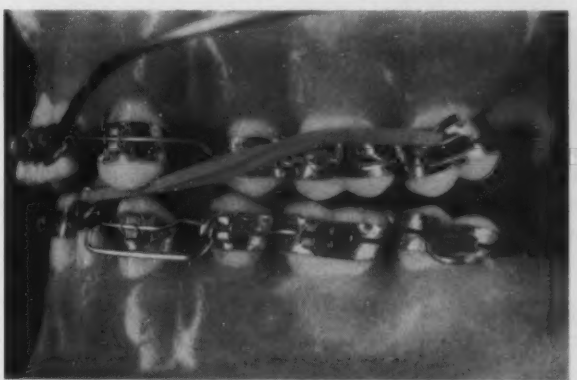
Fig. 7.—Horizontal loops (ligated to distal staple on cuspid bands) used to upright mesially tipped cuspids (below) and Class III mechanics and extraoral force used in conjunction with the horizontal loops (above).

Fig. 8.—Anterior view showing Class III elastics and extraoral force to upper arch while cuspids are being uprighted with horizontal loops.

tion of Class III elastics (Fig. 9). Thus, with the heavy maxillary stabilizing arch and extraoral force to resist forward movement of the teeth in the maxillary arch, the mandibular teeth are uprighted and set distally by means of

the jigs and Class III elastics. From time to time the tip-back bends in the mandibular arch may be increased as required, and the force is continued until such time as mandibular anchorage has been well prepared.

Fig. 9.



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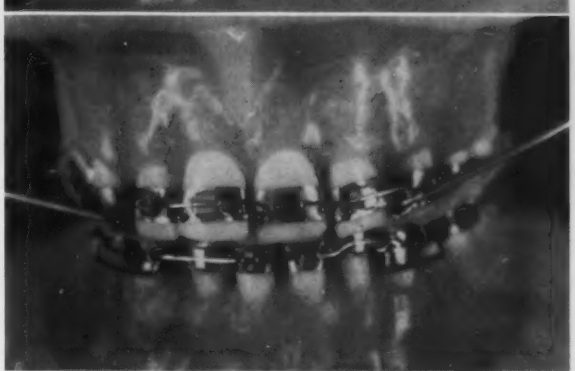


B.

Fig. 10.

Fig. 9.—Sliding jigs and tip-backs, shown here to tip back lower buccal teeth, with Class III mechanics. Upper arch re-enforced with tip-backs and extraoral force. Upper buccal teeth may be set up in the same manner by reversing the mechanics.

Fig. 10.—Lower cuspids being moved distally with compressible short coils compressed against cuspids. Buccal teeth have been tipped back and tied together into one unit, and coils have been activated against this unit. The lower arch slides through the brackets and tubes carrying lower incisors lingually at the same time. Upper cuspids may be moved back later in the same manner.

The process is now reversed. The heavy stabilizing arch, with tip-backs similar to those in the mandibular arch just described, is placed and tied back tightly from a stop loop that had been fashioned into the arch. The maxillary arch now becomes a 0.020 by 0.025 inch working arch. If necessary, the buccal

segments of the arch wire are reduced, and the sliding jigs are applied to the upper buccal teeth in the same manner as described for the mandibular arch. Now, with Class II elastics and extraoral force against the mandibular arch, if necessary, the upper buccal teeth are tipped back and distally to positions of anchorage preparation and advantage.

From this point on, the heavy stabilizing arch wire is again placed in the maxillary arch, and the light resilient working arch wire is placed in the lower denture. Tip-back bends are incorporated in both arches, equal to or slightly greater than those in the arches being replaced. In the mandibular arch wire, the buccal segments are reduced. The tip-backs are increased from time to time, and the cuspids are carried distally by means of short coils compressed between the intermaxillary hooks and the cuspid brackets. Class III elastics are used continuously, and extraoral force is applied against the maxillary arch for no less than fourteen hours daily (Fig. 10).

In this manner, the lower cuspids are retracted and the lower incisors are uprighted and carried lingually. Care should be taken to ligate all incisors together to prevent undesirable spacing as the lower cuspids move distally. If the anchorage requirements are not too great, the upper cuspids may be carried back by short coils compressed between the extraoral force hooks and the upper cuspid brackets at the same time that the lower cuspids are being moved. If anchorage requirements are great, however, this step is carried out later. As soon as the lower cuspids are moved as far distally as desired, they are tied to the buccal teeth to avoid undesirable forward movement and the lower incisors are carried lingually by the arch moving distally through the brackets and tubes and Class III elastics, after the short coils have been removed. Since lower tip-back bends have been increased from time to time, when all spaces are closed mandibular anchorage is still prepared. Compressed Bull loops may be used to accomplish this step (Fig. 11).

Due regard is given the position of the roots of the mandibular incisors and, as required, lingual root torque is used in this segment. This particular aspect of treatment must be carefully observed to avoid carrying mandibular incisor apices too far labially.

The process is now reversed by using the heavy stabilizing arch in the mandible and the light resilient arch in the maxilla. The lower arch is now tied back from loop stops, while on the upper arch the cuspids are retracted by compressible coils between the Class II hook and the upper cuspid brackets, exactly the same procedure as used in carrying the mandibular cuspids distally (Fig. 10). The upper arch carries tip-backs and is reduced in the buccal segments. Extraoral force, as well as Class II elastics, is applied to the Class II hooks to aid in carrying the upper cuspids, and later the upper incisors, distally, with short coils (Fig. 12). From time to time the upper tip-back bends are increased. As the upper incisors go lingually and are uprighted, it may be necessary to place marked labial crown torque in the incisal segment to keep the upper incisors going back bodily. If this is required, a heavy arch replaces the upper light resilient arch, but the buccal segments are reduced to allow the arch to slide through the brackets as the maxillary incisors move bodily distally. Frequently, at this stage finger springs are soldered to the

Fig. 11.

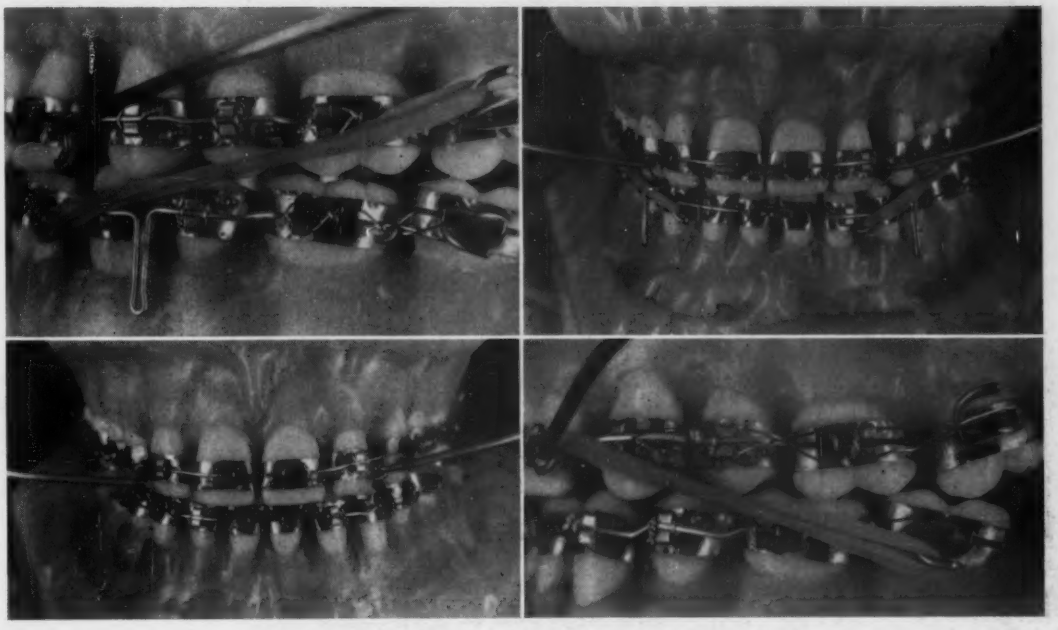


Fig. 12.

Fig. 11.—Lower incisors moved lingually with Bull loops (compressed and distendable). Class III mechanics and extraoral force to maxillary arch are continued.

Fig. 12.—Following distal movement of upper cuspids, the upper incisors are carried lingually by short coils compressed against stops on arch wire after the buccal teeth have been tied together as a unit. Class II and extraoral forces are continued. Torque in the upper incisal segment is controlled by heavy arch material in that segment while the buccal arch segments have been reduced in size to allow the arch to slide distally through the buccal brackets and tubes.

Fig. 13.

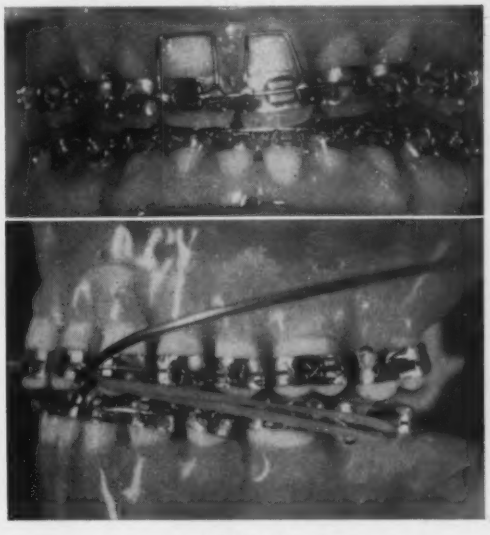


Fig. 14.

Fig. 13.—Springs placed against the labial gingival aspect of the upper incisors augment the lingual root torque to the upper incisors while Class II and extraoral forces are continued.

Fig. 14.—When all spaces are closed and mandibular anchorage is still maintained, Class II and extraoral forces adjust the mesiodistal tooth discrepancies.

upper arch wire to engage the gingival labial aspect of the upper incisors in a lingual direction, in order to further accentuate the lingual root torque (Fig. 13). Extraoral force in the form of high-pull headcap is used throughout this stage. When all maxillary spaces are closed, the Class II mechanics may be continued to correct the mesiodistal relationships with a new maxillary arch of 0.021 by 0.027 inch wire with loop stops to maintain arch length and tip-backs simulating those in the previous arch (Fig. 14). The buccal segments are reduced distal to the lateral incisor brackets.

As the application of Class II mechanics continues and the mesiodistal adjustment takes place, due consideration is given to the axial inclination of the maxillary incisors in a labiolingual direction, and, as required, the lingual root torque to those teeth is increased to keep them going back bodily.

If at this time there exists a midline discrepancy between the maxillary and mandibular teeth, the adjustment of this discrepancy is made by using Class II elastics on the side to be moved toward the midline and Class III elastics on the side to be moved away from the midline. This quickly adjusts mild midline discrepancies and allows for a better seating of the cusps of the buccal teeth. This step is illustrated in Fig. 15.

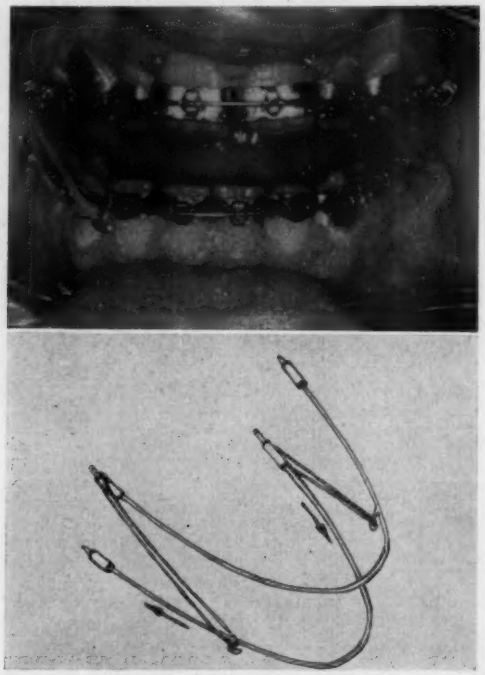
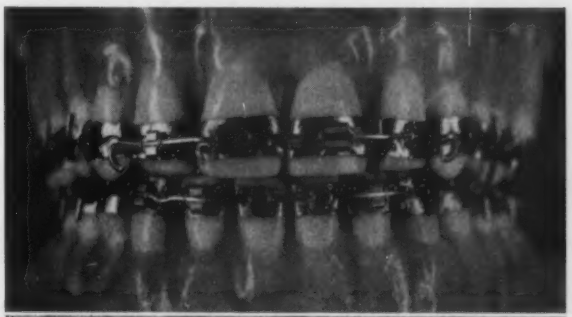


Fig. 15.—If at this stage midline adjustments are required, Class II elastics are used on the side to which the lower midline is to be moved and Class III elastics are used on the opposite side.

When the mesiodistal relationship is adjusted between the maxillary and mandibular teeth, hooks are strategically placed on the gingival aspect of both arches to receive vertical elastics to seat the buccal cusps (Fig. 16). At this stage, artistic bends are placed in both arches in the incisal segments to adjust for the artistic mesiodistal inclinations of these teeth.

When buccal cusps are seated, all the bands are removed except those from the last molars and the incisors. New ideal arches are fabricated to continue the artistic positioning and to close the spaces left by the removal of bands (Fig. 17). This is done by soldering stops 1 mm. mesial to the buccal

Fig. 16.



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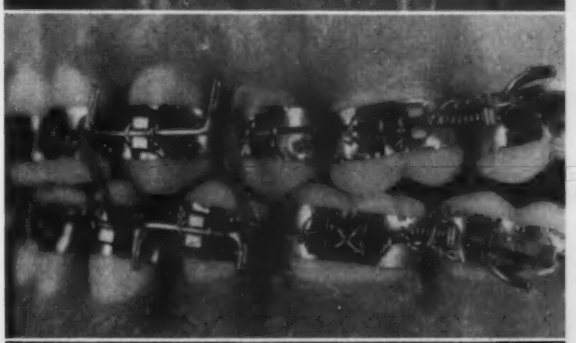
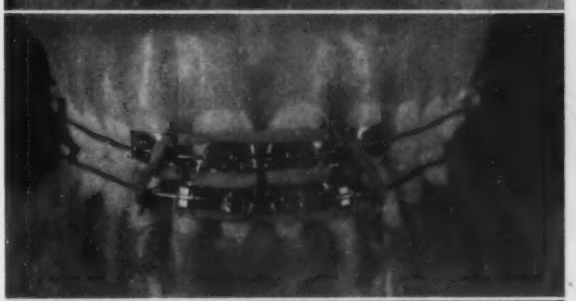


B.

Fig. 17.



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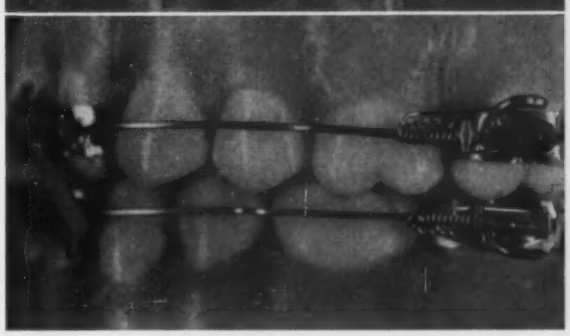

B.

Fig. 16.—After mesiodistal and midline adjustments have been made, cusps are seated in the buccal segments with vertical elastics, and remaining spaces are closed with short coils against stops on arch wires.

Fig. 17.—Buccal bands have been removed. Short coils close the band spaces. Artistic bends have been placed in the incisal arch segment and vertical elastics close open-bite in that segment when required.

tubes, and compressible short coils are placed mesial to these stops. These coils are lightly compressed by ligating them to the distal aspect of the buccal tubes or to the hooks soldered to the mesiobuccal-gingival aspect of the molar bands. In this step of the process, the band spaces are closed, and the buccal teeth further seat themselves in function. If required to seat the incisal edges at this stage, hooks are strategically soldered to the gingival aspect of both arches in the incisal segments for vertical elastics to close any bite opening. When this stage is completed, all appliances are removed and the case is retained. An acrylic Hawley retainer is used in the upper arch, and a soldered cuspid-to-cuspid retainer is used in the lower arch.

Fig. 18.—Photographs of case treated by expansion (left) and retreated twelve years later by extraction without expansion (right) showing the possibilities of facial esthetic improvement.

It is obvious that in an article as short as this a great amount of detail must be passed over. No effort has been made to bring into focus the many exceptions that might appear in treatment of the so-called bimaxillary protrusion cases. An effort has been made to describe, in general, the steps and procedures to be followed, and I feel quite certain that if this article were thrown open to discussion there would be many specific questions on the matter of procedures, such as re-establishing anchorage if it should give way. Suffice it to say that in the preparation of anchorage in cases involving a severe anchorage problem the distal marginal ridge of the last molar tooth might well be buried in the soft tissue before anchorage is adequately prepared and that all other buccal teeth would be so inclined distally as to make visible the mesial

marginal ridge and proximal contacts to the degree that the mesial surface of each succeeding buccal tooth would rise above the distal marginal ridge of each tooth in front of it.

One other point that I wish to make is that, to those who have not used the procedures herein described, it might seem that this technique is unusually difficult. Nothing could be further from the truth. One needs to but train himself in this technique, just as he must in any other, and become well acquainted with its goals and aims and with its technical procedures. These procedures, once mastered, reduce tremendously the difficulties of orthodontic therapy, for in following them one knows where he is going and has the therapeutic devices with which to gain his end in a relatively clear, precise, and planned manner. To many orthodontists, these procedures have been fruitful, in that both they and their patients feel today that orthodontic services rendered come closer to being dentofacial orthopedics than at any time in the past.

No claim is made that these procedures are faultless. Rather, it is claimed only that in my hands, and in the hands of many others, they have led to more improved orthodontic services for the patients.

I close with photographs of a patient whom I treated by an expansion technique and then, twelve years later, retreated by the removal of four first premolars and the uprighting of mandibular incisors after the patient had reached adulthood. This illustration rather graphically represents today's orthodontic possibilities (Fig. 18).

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ORTHODONTIC TREATMENT FOR THE CLEFT PALATE PATIENT

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INTRODUCTION

THE purpose of this article is to present the principles and procedures employed in the orthodontic treatment of cleft palate patients at the Hospital for Sick Children in Toronto.

In 1952, a program of orthodontics for cleft palate patients was initiated at the Hospital for Sick Children by Dr. Egil Harvold. Financial support was received through a National Health Grant and the Ontario Division of the Junior Red Cross. Many of the treatment principles which Dr. Harvold developed, as well as the appliances that he used, will be described in this article.

In 1955 a generous grant from the Atkinson Charitable Foundation made possible not only continuance of the program but also expansion and inclusion of other services in order that the problem might be approached on a team basis.[2] Out of some 450 patients examined by a consultation team, 226 are presently receiving orthodontic care.

The orthodontic management of cleft palate patients differs considerably from routine orthodontic practice. To appreciate these differences, it is necessary to understand certain basic information about cleft palate.

Incidence, Etiology, and Classification of the Different Types of Clefts.—The term *cleft palate* is commonly used to describe a wide variety of facial clefts involving the upper lip, maxillary alveolus, and palate. The incidence is fairly constant the world over and generally occurs in a ratio approximating one in 750. This incidence has been confirmed for the Province of Ontario.[7]

Little is known of the cause of the phenomenon. The only established etiological factors are genetic, and these are not well understood.[3] A positive familial history has been found for approximately one-third of the patients we have examined. It is probable that many clefts result from environmental disturbances, and clefts have been produced by such disturbances in animal experimentation.[12, 13]

When the embryologic processes forming the upper lip, maxillary alveolus, and palate unite only partially, or fail to unite at all, clefts result in those areas in which fusion normally would have taken place.[8] The different forms which these clefts assume may be classified into four primary types (Fig. 1). Clefts of

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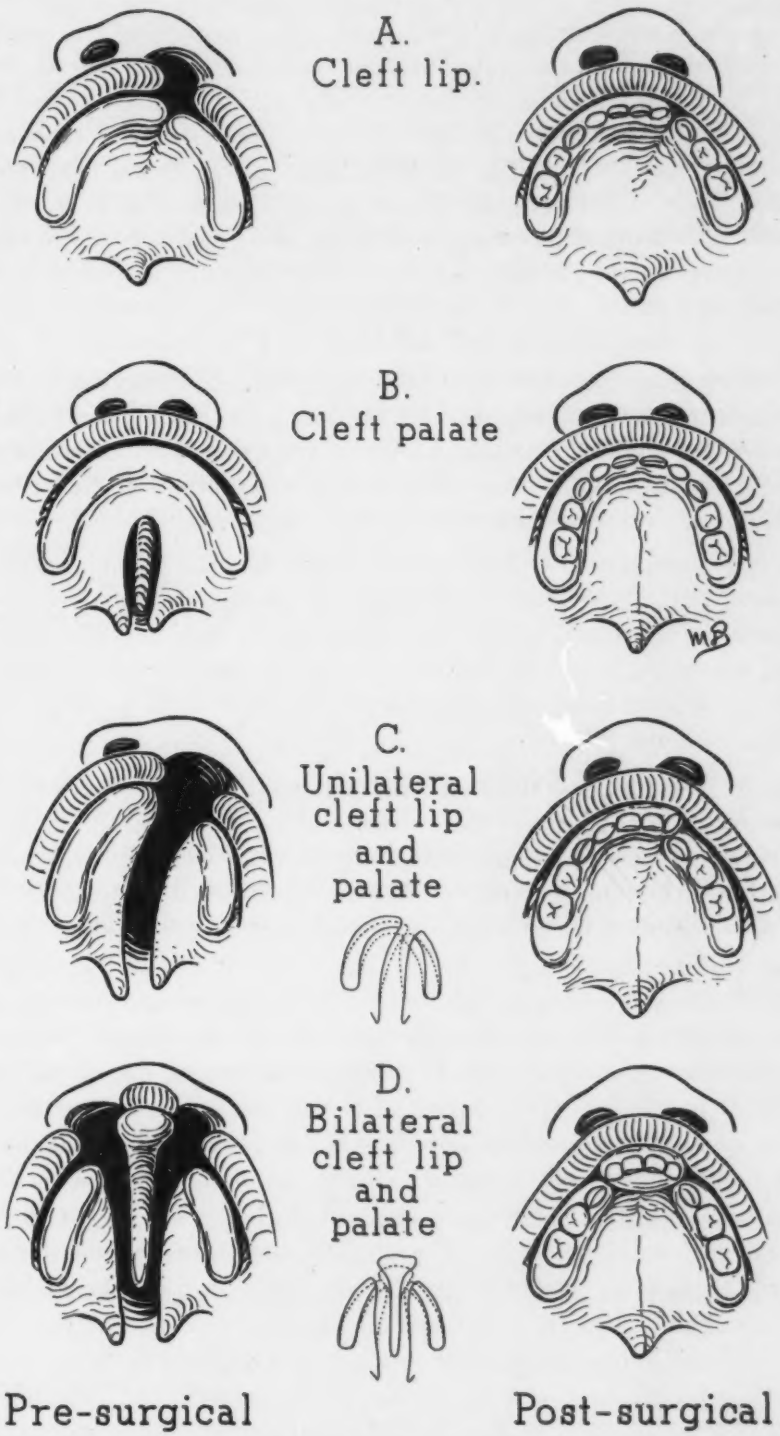

Fig. 1.—Illustrations of the four primary cleft types depicting presurgical and postsurgical deformities. The segmental "collapse" of the cleft lip and palate types (*C* and *D*) is illustrated by schematic diagrams.

the first type are those of the lip (and alveolus) and, while they are usually unilateral, they are occasionally bilateral. The degree of lip clefting is reflected in the degree of associated alveolar clefting.[10] Thus, clefts of this type will vary in degree from a notching of the lip, with little or no associated alveolar cleft, to the more complete lip and alveolar clefts, such as the unilateral cleft illustrated in Fig. 1, *A*. Clefts of the second type are those of the palate. They may merely divide the uvula or, as in Fig. 1, *B*, they may extend forward into the anterior portion of the hard palate. Where clefts of the above types are continuous with one another, we have the unilateral and bilateral clefts of lip and palate. These constitute the last two types, the complete forms of which are illustrated in Fig. 1, *C* and *D*.

The isolated clefts, that is, cleft lip (and alveolus) alone or cleft palate alone, constitute about 50 per cent of the total, the relative frequencies of the two types being about the same. Clefts of lip (and alveolus) with associated cleft palate constitute the other 50 per cent, the unilateral clefts outnumbering the bilateral clefts approximately two to one.

General Management.—The prime objectives in the habilitation of the cleft palate patient are the attainment of acceptable appearance and the establishment of adequate speech and masticatory function. The complexity of these and associated problems requires the integrated services of a team which includes the pediatrician, surgeon, speech therapist, dentist, and orthodontist, each specialist being dependent upon the others.

Surgical repairs are carried out to obtain soft tissue closure of the clefts. At the Hospital for Sick Children, clefts of the lip are operated on when the patient is about 3 months old and clefts of the palate when the patient is about 18 months old. In a few centers, the latter procedure is sometimes delayed until the age of 4 or 5 years in an attempt to reduce restrictions to maxillary growth.

In most cases in which speech therapy or guidance is necessary, such therapy is preferably instituted when speech is in its developmental stages. As speech difficulties usually result from inadequacies of the surgically reconstructed soft palate and deformities of the dentofacial structures, assistance which the surgeon, orthodontist, or prosthodontist can offer may be essential to the success of the speech therapist's efforts.

There are marked differences in dentofacial growth and development among the various types of cleft, and orthodontic management varies considerably. In isolated clefts of the lip or palate, where the maxilla is not divided, maxillary growth and development are not markedly affected and consequently the deformity is neither great nor difficult to treat by the usual orthodontic procedures. On the other hand, growth and development are markedly affected in clefts of the lip and palate (where the maxilla is divided), and they require rather special orthodontic management. Treatment of the latter cases has received considerable attention[9] and is also stressed in this article.

DENTOFACIAL GROWTH AND DEVELOPMENT AND ORTHODONTIC MANAGEMENT OF THE FOUR PRIMARY TYPES OF CLEFTS

Cleft Lip (and Alveolus).—When the cleft of the lip is slight, no associated alveolar defect may be found. Dental deformity is slight, or absent, and usually orthodontic treatment is not necessary.

In more complete "lip" clefts, where the alveolar clefting is more extensive (Fig. 1, *A*), the localized effects of a cleft passing through the alveolus will be seen without the modifying influence of divided maxillary segments. Usually, any adverse pressures exerted by the repaired lip have little or no effect upon the almost intact maxilla. The localized disturbance occurs in the region of the lateral incisor and is manifested by malformation and rotation of teeth adjacent to the cleft and frequently by the absence of teeth or the presence of supernumerary teeth. Supernumerary teeth are a common finding in the deciduous dentition, while the lateral incisors are very frequently missing (or at least poorly formed) in the permanent dentition.

Treatment is straightforward and may be carried out in the mixed or the permanent dentition. It is generally necessary to band the incisors, and we have successfully used both twin arch and edgewise appliances. The former is particularly applicable in mixed dentition treatment. Retention is often a problem, and in the most severe cases fixed splinting across the cleft region may be indicated.

Cleft Palate.—Surgical repair of partial clefts of the soft palate seldom affects dental development in any way. When it becomes necessary to carry the surgical repair onto the hard palate mucosa, however, the resulting scar tissue contraction often manifests itself in a dentoalveolar constriction. This constriction is generally localized to the posterior segments. If the cleft extends appreciably into the hard palate (Fig. 1, *B*) and the surgical repair is correspondingly more extensive, a general maxillary underdevelopment may result. The underdevelopment is usually slight and insufficient to cause any crowding in the deciduous dentition, but considerable crowding may be present in the mixed and permanent dentitions.

In order to obtain the most ideal end result, it is generally necessary to treat early, thereby removing any restrictions to maxillary growth imposed by cross-bite relationships. In many ways the isolated cleft palate problems resemble noncleft problems closely and may be treated as such.

Expansion may be accomplished by a number of appliances. Although the expansion appliance developed by Harvold, which will be discussed in some detail later, is designed primarily for segmental movement, we have also found it to be most efficient for simple dentoalveolar expansion.

If the original constriction was not severe, then cuspal interdigitation in the buccal segments and a positive overbite in the incisor segment will usually be sufficient for retention. Occasionally, it may be necessary to use a palatal prosthesis or fixed lingual appliance.

Unilateral Cleft of Lip (and Alveolus) With Associated Cleft Palate.—

Growth and development: Asymmetry is one of the most prominent features of the unilateral clefts of lip and palate.[5] Anteriorly, the cleft simulates that of a complete or extensive unilateral cleft of the lip and alveolus. Posteriorly, the picture often varies somewhat from that of an extensive isolated cleft palate in that the nasal septum is generally fused with the palate on the noncleft side.

Presurgically the segments of the maxilla are often widely separated. Almost invariably, however, they rapidly move medially into apposition following repair of the lip. This movement is primarily a rotation in the horizontal plane about a point approximating the zygomaticomaxillary sutures in the region of the buttresses (Fig. 1, *C*). Some rotation in the frontal plane may occur, and this is manifested by a lingual tipping of the alveolar processes.

The degree of medial shifting or "collapse" of the segments is determined by the tightness of the lip repair, the development of the alveolar processes in the region of apposition, and by the contraction forces introduced by the surgical repair of the palate. The development of adequate incisor overbite, with positive overjet, may reduce the degree of collapse in the anterior or premaxillary area.[6] The "collapse" is not symmetrical but rather more pronounced on the cleft side. To add to the facial asymmetry, the mandible very often deviates laterally in a functional accommodation to the existing occlusion.

The reduction of arch length is generally insufficient to produce crowding of the deciduous dentition. However, the relatively larger size of the permanent teeth, coupled with increased maxillary constriction with age (most marked during the transition from mixed to permanent dentition), results in considerable crowding.

The total growth and development of the maxilla may be affected.[4] Thus, a general anteroposterior deficiency may add to any premaxillary "collapse" to give the mandible a relatively prognathous appearance.

Also, deficiencies in vertical maxillary growth may become appreciable with increase in age. These are caused by resistance offered by the tongue to the eruption of teeth in constricted or medially displaced maxillary segments. If the reduction of vertical growth is general, it is associated with excessive freeway space at rest and overclosure at occlusal contact. Deficiencies in vertical growth are often limited to regions in which the "collapse" is marked and are manifested by an open-bite in these areas.

Timing of treatment: In the above, there are many indications for early treatment. The deformity is less in younger patients, and a satisfactory orthodontic result is more easily obtainable. If the maxillary segments are carefully repositioned in a symmetrical manner, the mandibular deviations automatically correct themselves in accommodation to occlusion with the corrected maxillary arch. Expansion does much to alleviate crowding by increasing arch length, and early correction of anterior cross-bite tends to lessen anteroposterior

growth discrepancies between the maxilla and the mandible. The problem of vertical maxillary development is not great at lower age levels and can often be avoided if the maxillary segments are moved into normal position before the transition from the mixed dentition to the permanent dentition.

In addition to orthodontic considerations, the importance of early treatment in assisting the more normal development of the functions of speech, mastication, and deglutition cannot be overlooked. In some children, the psychological implications of growing up with a dentofacial deformity may assume considerable importance.

The advantages of early treatment outweigh the disadvantages of multiple periods of active treatment interspersed with long periods of retention. Where some follow-up treatment is necessary in the permanent dentition, it is rarely extensive. Usually the more severe cases benefit most by early treatment. In patients in whom the deformity is slight, satisfactory results may be obtained by treatment in the permanent dentition.

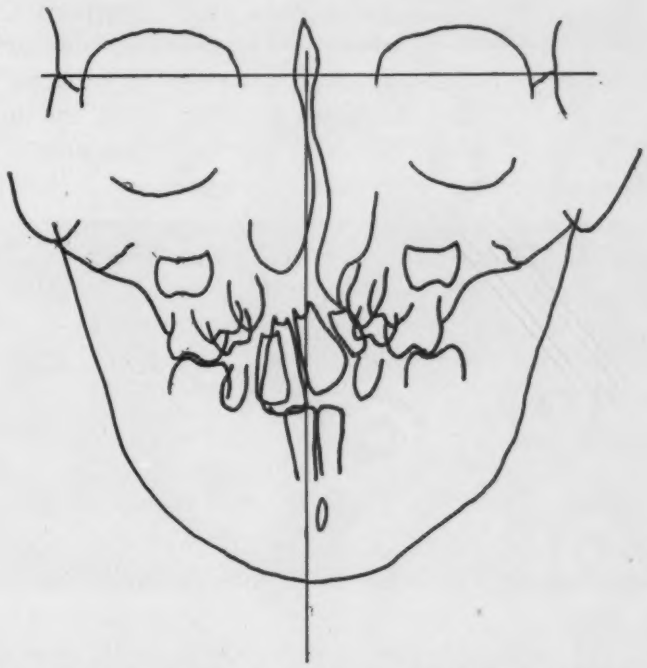

Fig. 2.—The "x-line" superimposed upon the tracing of the posteroanterior cephalometric radiograph of a patient with unilateral cleft lip and cleft palate. The line is drawn through the base of crista galli at right angles to a horizontal line joining the zygomaticofrontal sutures.

Case analysis: In order to determine the asymmetrical position of the segments prior to repositioning, and hence guide the relative movement on the two sides, the "x-line" analysis is very helpful.[5, 6] It is applied to the anteroposterior cephalometric radiograph, a facial center line being constructed from landmarks in the upper face as shown in Fig. 2. Thus, it is possible to assess the lateral position of the maxillary segments and also the lateral position of the mandible and other dentofacial structures.

Maxillary expansion: Various appliances have been used to effect expansion in cleft palate cases, such as the expansion screw plate popular in many European countries and the Arnold expander[11] popular in the United States. The appliance which Harvold developed specifically for segmental movement is preferred at the Hospital for Sick Children. It consists of a lingual arch with auxiliary recurve springs. Details of construction are shown in Fig. 3.

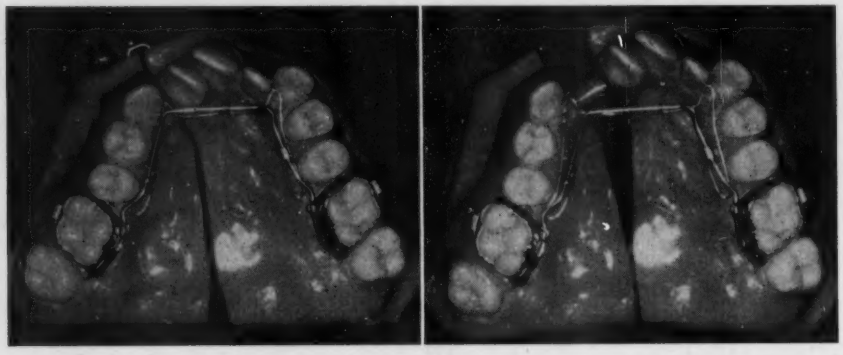

Fig. 3.—Expansion appliance developed by Harvold. The lingual arch is 0.031 inch and the auxiliary springs are 0.016 inch in diameter. The ends of the arch are bent vertically upward to serve as posts, and the appliance is inserted by placing these posts into the lingual tubes and "springing" the arch gingivally to the retention lugs.

Fig. 4.—Study models of a unilateral cleft of lip and palate (before and nearing the completion of orthodontic treatment) demonstrating segmental repositioning.

The expansion appliance developed by Harvold may be so activated as to control the resultant movement accurately. The auxiliary springs function differently, depending upon the region and nature of adjustment. Also, where necessary, the main arch may be activated for expansion, and variation in the buccolingual angulation of the posts, through their torque action, may be employed to assist in controlling the relative expansion on the two sides. If the expansion force is correctly applied, the repositioning of the maxillary segments is very rapid, usually being completed in three to six months. The repositioning is the direct reverse of the collapse movement (Fig. 4).

Following expansion, it is necessary to employ some form of retention in order to maintain the corrected position of the maxillary segments. Such precautions must be taken both during and between subsequent periods of active treatment. "Interim" retention appliances may consist of a plain lingual arch or maxillary prosthesis (Fig. 5, *D*). Modifications may sometimes be necessary in order to permit the eruption of individual permanent teeth lingual to the line of the deciduous arch.

Correction of anterior cross-bite: Anterior cross-bite correction in the deciduous dentition may do much to assist in establishing a more normal growth pattern. It may be contraindicated, however, for many cases nearing the mixed dentition stage. This is because correction in the deciduous dentition does not ensure labial eruption of the permanent incisors and, in fact, deciduous root movement may tip the permanent incisors even further lingually. For these reasons, anterior cross-bite correction is frequently delayed until the permanent incisors have completed their eruption.

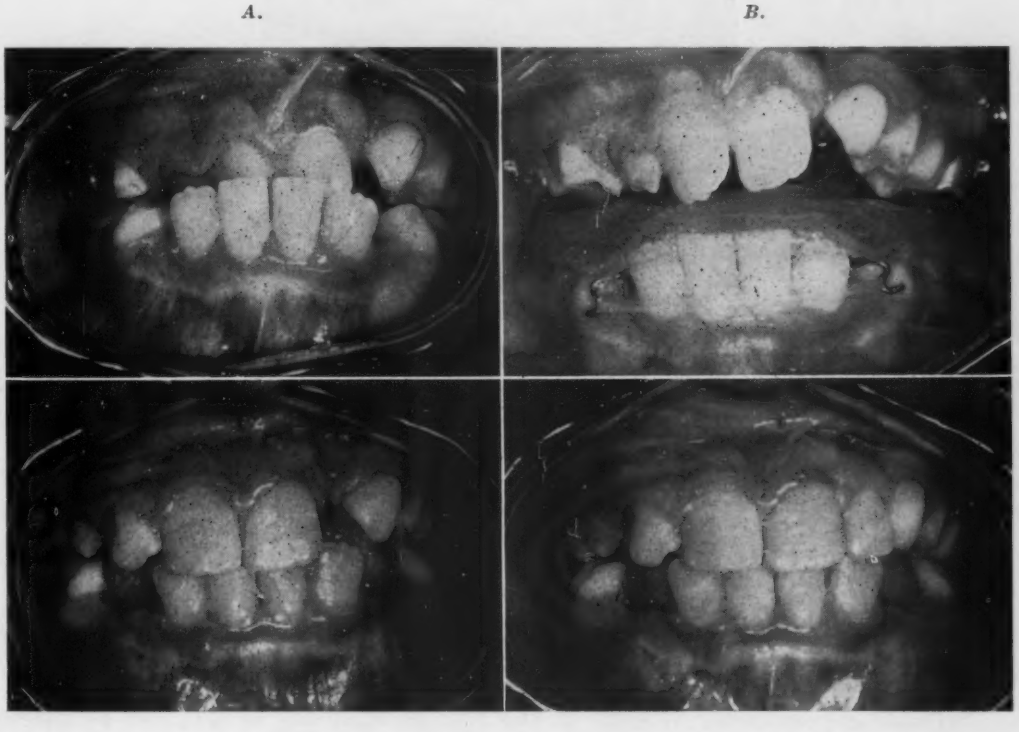

Fig. 5.—Anterior cross-bite correction, in the mixed dentition, for a patient with a unilateral cleft of lip and palate. *A*, Maxillary expansion completed and the mandibular deciduous cuspids extracted. *B*, Initial appliances for anterior cross-bite correction. *C*, Anterior cross-bite corrected and incisors aligned. The mandibular first deciduous molars have been extracted. *D*, Interim retention prosthesis.

A lingual arch with finger springs is quite efficient for the initial alignment and labial movement of crowded, lingually placed maxillary incisors. However, excessive use tends to tip the anchor teeth distally. In addition to preventing this tipping a labial appliance with banded incisors is more efficient for

correcting rotations, handling necessary root movements, and ensuring adequate overbite for retention. The twin arch is particularly well suited although a modified edgewise appliance, or at least its brackets, may be used.

Some form of mandibular bite block or bite plane may be necessary when the overbite is considerable. If eventual mandibular premolar extraction is deemed necessary to relieve a tooth size problem or to compensate for a maxilla deficient in anterior growth, the mandibular deciduous cuspids may be extracted and an anterior elastic added to the bite block to retract the incisors (Fig. 5).

Center-line correction may sometimes be a problem. Excessive movement toward the cleft may denude a large part of the root surface of the tooth adjacent to the cleft. In most cases, however, the growth potential of the alveolar bone is adequate, and a suitable result may be attained (Fig. 5).

Fig. 6.—Appliance designed by Harvold to correct deficiencies in maxillary vertical development. The arms extending from the palatal prosthesis are of 0.029 inch (diameter) round wire and are activated occlusally.

Correction of deficiencies in maxillary vertical development: Where segmental collapse is marked and repositioning of these segments is delayed until the permanent dentition, problems of deficient maxillary vertical development arise. To aid in the solution of these problems, Harvold designed an effective appliance. As illustrated in Fig. 6, arms from a palatal prosthesis extend gingivally to lugs on banded maxillary teeth. Occlusal activation of the arms stimulates the eruption of the teeth. The appliance may be used to best advantage following lateral expansion of the maxillary segments and prior to any anterior cross-bite correction (Fig. 7).

Detailed positioning of teeth in the permanent dentition: It will be necessary to finish many cases with a multiband appliance, such as the edgewise. Multiband appliances are inefficient in controlling segmental movement, and precautions should be taken to maintain the proper position of the segments already attained while moving teeth within them. If the arch is of proper form and its length fixed, little difficulty will be encountered. In those procedures involving space closure (decrease in arch length), however, one must take care to ensure sufficient rigidity and proper arch form in order to prevent "recollapse" of the segments.

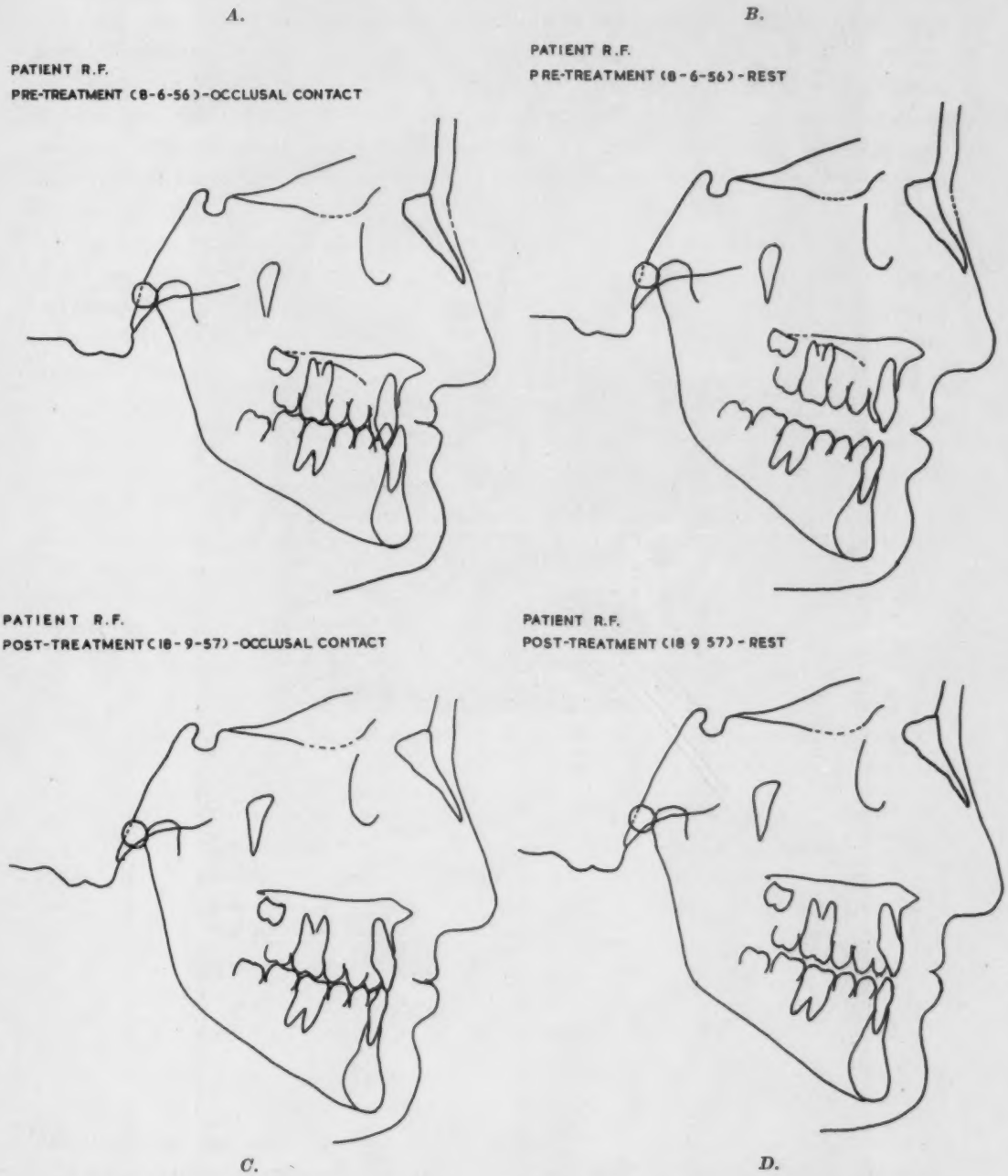

Fig. 7.—Tracings of the cephalometric radiographs of a patient with unilateral cleft lip and cleft palate before and after fifteen months of orthodontic treatment. A period of maxillary expansion was followed by correction of deficient maxillary vertical development (using the appliance illustrated in Fig. 6), the remaining teeth then being banded to facilitate anterior cross-bite correction and tooth alignment. The tracings demonstrate an improvement in profile at occlusal contact and a more normal freeway space at rest position.

Fig. 8.—Study models of two patients with unilateral cleft lip and cleft palate before and after orthodontic treatment. Retention prostheses are shown on the right.

Retention prostheses: To finish these cases, some kind of permanent maintainer must be constructed. This may take the form of a simple partial denture replacing any missing teeth and, by careful clasping, rotations may be stabilized and the recurrence of open-bite prevented (Fig. 8).

Eventually we anticipate splinting a large number of our cases. These splints are constructed across the cleft, any missing teeth being replaced as pontics. They require two abutment teeth on either side of the cleft and have been used successfully in Norway.[1] Also, any lack of adequate bony support for teeth adjacent to the cleft may be supplemented in this manner.

Bilateral Cleft of Lip (and Alveolus) With Associated Cleft Palate.—In complete bilateral clefts of the lip and palate, the premaxillary segment is separated from the two lateral maxillary segments and suspended from the nasal septum (Fig. 1, *D*). It would appear that this segment consists simply of teeth and alveolar bone. The more teeth it contains, the larger the segment, and if these teeth are lost the remaining segment resorbs almost completely.

Before lip surgery the premaxillary segment is carried forward at an "uninhibited" rate by growth in the nasal septum. The repaired lip subsequently retards this forward growth, and gradually the premaxillary segment is brought into a more normal relationship with the remainder of the maxilla. The crowns of the teeth are "molded back," and by the time the permanent incisors erupt they are generally tipped posteriorly about 45 degrees, with their crowns in linguoversion.

The anteroposterior position of the premaxillary segment is an important determining factor in the degree and nature of the collapse of the lateral segments. The more posterior its position, the more efficiently it prevents the medial movement of the lateral segment. The "collapse" movements and the wedging action of the premaxillary segment are depicted in Fig. 1, *D*.

As with the unilateral clefts of lip and palate, it is generally conceded that early treatment is preferable. However, orthodontic management of the bilateral clefts differs from that of unilateral clefts in the unique problems associated with the premaxillary segment and in the fact that asymmetry is no longer a dominating factor. It has been our experience that in all but the most severe protrusions the premaxillary segment and contained teeth should be maintained in as normal a position as possible until the age of 12 to 13 years, when most of the permanent dentition has erupted. Then a decision may be made as to whether or not the teeth in this segment are to be retained. Other reasons for their removal (besides position) include hypoplasia and hypocalcification.

The mechanics of orthodontic treatment are much the same as for the unilateral clefts of lip and palate. Even though anterior cross-bite and maxillary center-line correction are essentially segmental movements, appliance therapy does not differ greatly. Interim retention by removable prosthesis is generally preferable, due to the high incidence of residual anterior palatal and alveolar openings into the nasal cavities which may be covered in this manner.

Permanent retention of these cases is almost always provided by a removable prosthesis. Ideally, it should be placed over splints across the clefts. In those cases in which the maxillary incisors are removed, it may be necessary to carry out certain surgical procedures, such as trimming or even surgical removal of the premaxillary segment, before a prosthesis is inserted.

LIMITATIONS OF ORTHODONTIC TREATMENT

We have already seen some of the limitations in handling severe cases of bilateral clefts of the lip and palate without the aid of the surgeon and prosthodontist. Also, underdevelopment of the maxilla may be quite severe in unilateral or bilateral clefts of lip and palate, or even in cases of isolated cleft palate. If this underdevelopment is associated with a well-developed or overdeveloped mandible, it may be very difficult or impossible to reduce the anteroposterior discrepancy by orthodontic treatment alone. Prosthetic replacement of the maxillary incisors or anterior teeth may be sufficient in some cases, whereas in others surgical correction of mandibular prognathism is indicated.

In most cases, however, as those illustrated in Fig. 8, the potentialities of orthodontic treatment are very good.

SUMMARY

The diagnostic and treatment concepts employed by the orthodontists working in the Cleft Palate Research and Treatment Centre at the Hospital for Sick Children in Toronto have been presented. Many of these concepts were introduced by Dr. Egil Harvold.

Dentofacial growth and development, orthodontic management, and prosthetic retention have been described for each of the four fundamental types of clefts: (1) cleft lip (and alveolus), (2) cleft palate, (3) unilateral cleft lip (and alveolus) with associated cleft palate, and (4) bilateral cleft lip (and alveolus) with associated cleft palate.

Some of the limitations of orthodontic treatment, particularly those related to severe deficiencies in anterior growth of the maxilla, were discussed.

In recent years numerous advances have been made in the habilitation of cleft palate patients. It is hoped that, with continued improvements in treatment, an ever-increasing number of these handicapped children may proceed to adulthood with an acceptable appearance, understandable speech, and a healthy mental outlook.

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THE SCIENCE, PHILOSOPHY, AND ART OF ORTHODONTIC PRACTICE

A Summary of Forty Years of Orthodontic Experience and Observation

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THE first and most important point in dealing with any problem is to endeavor to obtain the most comprehensive, all-inclusive concept of the nature of the problem. It has been said that *perspective* is the most important element of wisdom.

In order to appreciate properly the fantastic scope and bewildering complexity of orthodontics, it is first necessary to have a fairly good knowledge of a number of basic sciences and, above everything else, an appreciation of their relationship to each other from the standpoint of an all-inclusive whole.

Fig. 1 has been designed as a panoramic sketch of the basic sciences involved in the orthodontic problem and, under their respective headings, the important factors which must be considered individually and collectively in every specific case which comes under orthodontic study.

Anthropology is the most logical science to consider first, for it affords the most comprehensive viewpoint from which to scan the whole panorama of the orthodontic problem from its inception to its final and logical objectives. This immediately presents the staggering facts that eons of time and untold generations of the human race form the background for every orthodontic consideration in which the relentless and ever-changing elements of heredity and environment are constantly interacting in the production of incalculable numbers of ever-new, more complicated, and more unpredictable human genetic patterns. The two and one-half billion persons who constitute the present human population are but a mere sample of the incalculable number of generations that have preceded them and out of which, by comparison, we have only recently been experimenting with an infinitesimal fraction of those who have been subjected to the tender mercies of orthodontic therapy.

By comparative "infinitesimal numbers" is meant the total number of all the persons who have been given orthodontic treatment by all the orthodontists of the world from the inception of orthodontics to the present time. This comparison is based on a simple ratio of the astronomical totals of population to the number of cases treated. This number must again be subdivided into the relatively submicroscopic number of cases that may happen to have fallen to

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the lot of each individual orthodontist and in which he undoubtedly will have been confronted with some extremes of variation. Figs. 2 to 14 represent a few samples of the infinite variations in the sizes, proportions, and relationships of the tissues involved in the orthodontic problem influenced at all times

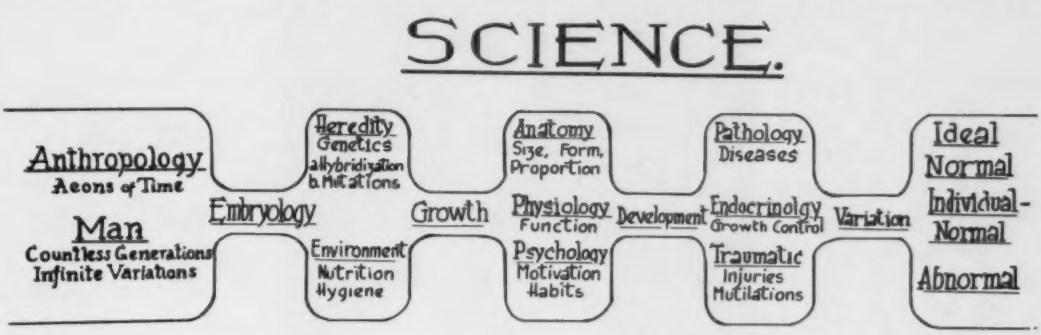


Fig. 1.

by the genetic pattern, environmental conditions, and the ordinary vicissitudes of life. As there is no duplication in Nature, it is quite impossible to classify these variations on any other basis than broad qualitative generalities.

Figs. 2 to 5 present extremes of genetic patterns.

Fig. 2.

Fig. 3.

Figs. 2 and 3.—A very unsatisfactory dental occlusion.

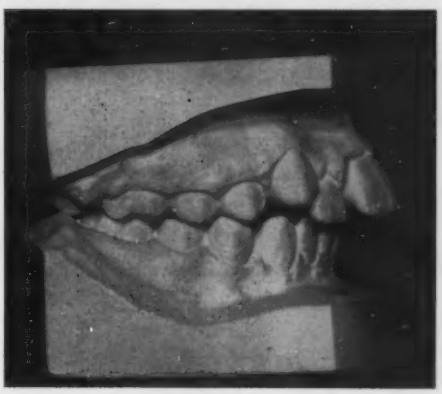


Fig. 4.—Another unsatisfactory dental occlusion.

Fig. 5.—An unsatisfactory facial balance.

Fig. 6.

Fig. 7.

Figs. 6 and 7.—There is no predictability as to hereditary combinations of the individual, even among those who are closely related. These models were taken from a full brother and sister.

There is no predictability as to hereditary combinations, even among those who are closely related. Figs. 6 and 7 represent models taken from a full brother and sister.

Figs. 8 and 9 show two cases of extreme variation between the sizes of the teeth and the resultant effect on the facial harmony. These two photographs were blown up to the same facial size in order to show this disparity clearly.

Figs. 10 and 11 show a case in which function induced by malocclusion has seriously affected the harmony of the face.

Fig. 12 shows two cases of structural imbalance in which *A*, with a full complement of teeth, does not have sufficient bony development to accommodate them, whereas *B*, with eight teeth congenitally missing, has more than enough to accommodate them all. This shows that there is very little relationship between the volume of tooth substance and the sizes of the jaws.

Fig. 13 shows a nice little girl among the millions who could be benefited by a little orthodontic therapy.

The young gentleman shown in Fig. 14 may have to subject himself to some myofunctional exercises as a preparatory measure for movie stardom. The tonicity of the muscles is an important element in all orthodontic problems.

Fig. 8. Fig. 9.

Figs 8 and 9.—Two cases of extreme variation between the sizes of the teeth and the resultant effects on the facial harmony. These two photographs were reproduced in the same facial size in order to show this disparity clearly.

With regard to anthropology, the late Dr. Ernest Albert Hooton, celebrated anthropologist of Harvard University, had not lost his sense of humor when he said:

"Anthropology reveals many things which most persons prefer not to know, since it harps upon humble and even bestial origins, regards the present status of our species without approbation, and can predict for the men of the future no apotheosis but only a multiplication of psychoses, dental caries, malocclusions and fallen arches, together with a full retention of his aboriginal cussedness."

Fig. 10.

Fig. 11.

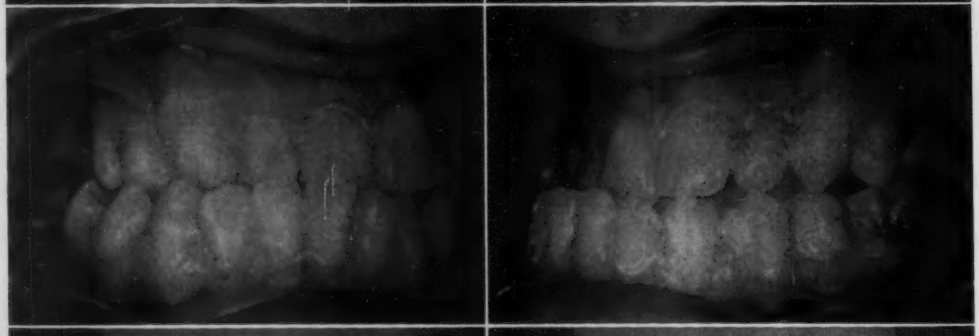


Fig. 12.

A. *B.*

Figs. 10 and 11.—A case in which function induced by malocclusion has seriously affected the harmony of the face.

Fig. 12.—Two cases of structural imbalance in which *A*, with a full complement of teeth, does not have sufficient bony development to accommodate them, whereas *B*, with eight teeth congenitally missing, has more than enough to accommodate them all, showing that there is very little relation between the volume of tooth substance and the sizes of the jaws.

Fig. 13. Fig. 14.

Fig. 13.—A nice little girl who could benefit from orthodontic treatment.
Fig. 14.—Muscular tone has much to do with facial symmetry.

In his book entitled *Apes, Men and Morons,* Dr. Hooton also said: "Among the students of man, there is suspicion amounting to a virtual certainty that the numerous anatomical variants are sorted into racial physical combinations through the activities of certain glands in the body, the pituitary, thyroid, parathyroids, thymus, adrenals and gonads. The secretions of these glands are the regulators of growth and sex differentiation and perhaps of metabolic and other vital processes. These are their real jobs, but they amuse themselves in their spare time by shaping variously the nose and the head, fooling about with the form of the hair, making blondes and brunettes, and otherwise disporting themselves in the fabrication of meaningless anatomical variations."

Dr. Hooton also doubted whether man's evolutionary status has improved appreciably since the end of the glacial ages and believed that it would get worse unless "the reckless and capricious breeding of protected inferiors" is stopped.

It is quite obvious to any observing orthodontist, however, that there are many physically and mentally superior human beings with very unsatisfactory dental occlusions which can be attributed mainly to unfortunate genetic matings.

Since the teeth and their surrounding tissues are amenable to improvement if approached with some degree of intelligence, the specialty of orthodontics has come into being, suffering though it is at present from the growing pains of youth and the inherent ignorance, stupidity, and intolerance of those of us who have applied ourselves to the fantastic complexity of its problems.

If we attempt briefly to define orthodontics in its most comprehensive way, we might say that it consists of bold and audacious attempts to alter the entire natural genetic and functional patterns of certain specific, unique, infinitely variable, scientifically incalculable, and unpredictable human beings. These changes include their teeth, bones, temporomandibular joints, and esthetic facial proportions. To be more specific, the factors involved include the whole gamut of heredity and environment, the infinite variations and combinations of anatomic sizes, proportions and relationships, physiologic functions, psychologic motivations and habits, diseases, endocrine imbalances, traumatic injuries, mutilations, and gross abnormalities. The resultant composite combinations which all these factors, with their infinite variations, are capable of producing must be appraised and balanced by the would-be orthodontist into single, all-inclusive, specific, and individual mental pictures and, when judged unsatisfactory, they must be altered by natural and artificial means into other specific, unique, all-inclusive, three-dimensional arrangements which will remain in satisfactory and stable conditions of structural, functional, and esthetic equilibrium.

All this adds up to just one supremely all-important and inescapable fact:

Orthodontics is predicated on the infinite variations of the human organism and the uniqueness of the individual.

With these fabulous figures always freshly in mind, together with the fantastic combinations of interrelating factors as illustrated in Fig. 1, it should be perfectly obvious that not even by the wildest stretch of the imagination is

it possible to conceive of any plan or system by which the problem can be dealt with along purely scientific or formulative lines. All attempts based on statistical and orientative data are so hopelessly and abysmally inadequate in dealing with the infinite variations of the individual on such a stupendous scale that they can only result in some absurd examples of this line of thinking. This is the price of *subjective* thinking.

If, on the other hand, the whole line of thought is just reversed by thinking *objectively,* using only a very small amount of very necessary but unavoidable imagination, the whole atmosphere becomes considerably clarified.

Orthodontics is so vast in its scope and its ramifications that there is nothing more futile and frustrating for the would-be orthodontist than to be misled by any of the schemes which cramp the freedom of his imagination, such as constrictively conceived classifications, delusive diagnostic diagrams, or the travesty of trying to trammel the tortuous trials of treatment with one trite type of technique.

SCIENCE—PHILOSOPHY—ART

In dealing with the problems of life, man always has at his disposal and uses, whether he realizes it or not, three basic means of approach. These are the scientific, the philosophic, and the artistic. The success which he may expect to attain in any effort depends upon the nature of the problem and the relationship of these three methods of approach to it.

Fig. 15 shows diagrammatically the relationship which science, philosophy, and art bear to each other. It will be noted that the largest space has been allotted to science, since it is much easier to be a scientist (of sorts) than it is to be a philosopher or an artist. In fact, in the ascent to the peak of this triangle, the persons who can qualify for all these characteristics, unfortunately, become rarer and rarer and there are many who cannot qualify at all.

Science and art, mellowed at all times by a little philosophic reasoning, have their definite spheres of usefulness in orthodontics, but the employment of either one or the other beyond its reasonable boundaries has been responsible for some of the greatest absurdities that have been inflicted on the specialty, together with the waste of atrocious amounts of time and effort in investigations which are obviously of little, if any, practical value and which have served only to confuse the main issues and completely misguide and bewilder the thinking of the beginner.

One of the main problems in orthodontics today lies in the struggle between two basically antagonistic types of personality and the equally basic divergent trends of thought by which each is dominated. These two types are (1) the academically minded theorists who are primarily interested in teaching and are quite naturally endeavoring by every means possible to reduce orthodontic problems to a set of rules and regulations which can be handed over to their uninitiated students and (2) the realistically minded natural clinicians who are interested in nothing but the actual ways and means by which to obtain the best

clinical results. Thus, we have the differences of opinion and viewpoint between the classicists and the romanticists, the theorists and the realists, the analytic and subjective-minded introverts and the objective and synthetic-minded extrovert, the concrete-minded "system seekers" and the perspective-minded "principle" pursuers.

Professor William Morton Wheeler stated this clearly when he said: "On reviewing my students and the mature investigators I have known during the past half-century, I find that most of them belong to two extreme types, while the remainder are intermediate or ambiguous composites. These extremes correspond with the romanticist and classicist types, respectively. The more numerous romanticists or extroverts are the naturalists; the classicists or introverts are the biologists in the strict sense."

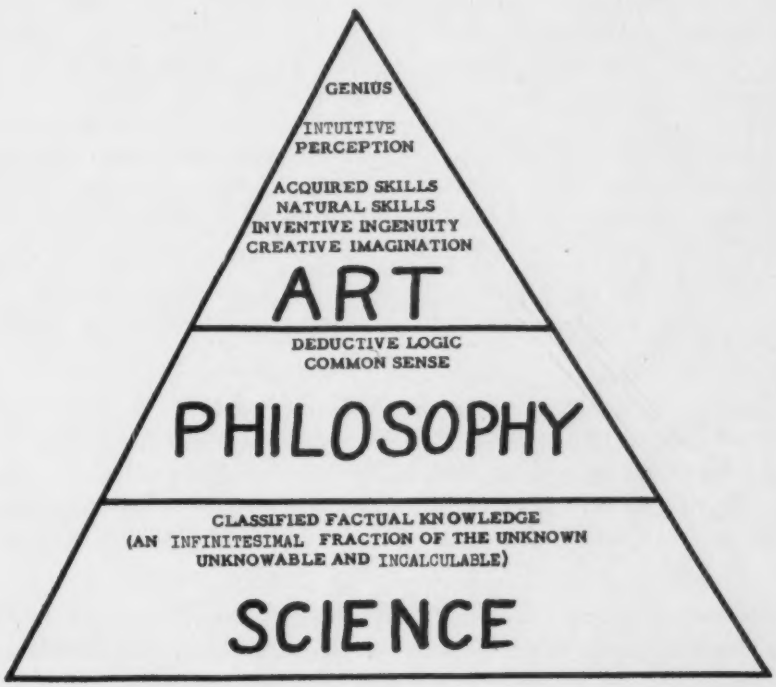


Fig. 15.—The three approaches to all the problems of life. It will be noted that, starting with *science* as a basis, the qualities that are necessary to produce a highly efficient orthodontist must necessarily include correct proportions of all three. They increase in subtlety as they ascend the scale through philosophy up to the highest peak of *art*, which is intuitive perception beyond which there is to be found the rarefied atmosphere of *genius*. It is much easier to become a scientist than it is to be a philosopher or an artist. The persons who can qualify for all these gifts become rarer and rarer and there are, unfortunately, many who cannot qualify at all.

The naturalist is mentally oriented toward and controlled by objective, concrete reality and, probably because his senses (especially those of sight and touch) are highly developed, is powerfully affected by the esthetic appeal of natural objects. He is little interested in, and may even be quite blind to, abstract or theoretical considerations. He is primarily an observer, deeply impressed by the overwhelming intricacy of natural phenomena and reveling in

their very complexity. He is, therefore, more or less irrational, intuitive, receptive, and passive in his attitude toward natural objects; he is synthesizing rather than analyzing.

The biologist in the strict sense, on the other hand, is oriented toward and dominated by ideas and is rather terrified or oppressed by the intricate hurly-burly of concrete, sensuous reality and its multiform and multicolored individual manifestations. His will to power takes the form of experimentation and the controlling of phenomena by capturing them in a net of abstract formulas and laws. He is a denizen of the laboratory. His besetting sin is oversimplification and the tendency toward undue isolation of the organisms that he studies from their natural environment.

The naturalist seems to represent the more youthful type; the biologist, the more mature type. For this reason a naturalist may develop into something of a biologist, but a biologist never becomes a naturalist. Occasional persons may combine the characteristics of both types. The naturalist never feels really at home in a university environment, probably because university faculties include such a large number of introverts.

The naturalist and the nature lover will always be with us. No matter how far the naturalist may specialize in his study of single groups of organisms, he is always keenly aware both of the limitations of his specialty and of its relationship to the whole realm of living things. Such modesty is not always apparent in the biologist in the strict sense, for he is not engaged in sympathetically exploring the contours of nature but in determining the extent to which phenomena conform with his experimental, metrical, and therefore highly rational procedure.

Science alone can seldom solve anything of a biologic nature, but when a problem is obviously beyond the scope of scientific appraisal, it is the height of stupidity not to call into play those extrascientific faculties with which everyone is endowed but which the most gifted are usually the most modest about asserting.

This modesty in top-drawer orthodontists is easily understandable. Any man who has spent a lifetime in the active practice of orthodontics can hardly look back on his efforts, however successful they may have been as a comparative average, without a feeling of deep humility, amounting at times to occasional moments of dark, dismal, despondent despair. He may enjoy basking in retrospect in the sunshine of his successes, with the attendant compliments that he may have received, but inevitably there are the memories of his failures which, like specters in the night, rise to haunt him and point the accusing finger at his stupidity, incompetence, carelessness, laziness, and all his other forms of human weaknesses, ignorance, and plain cussedness.

On the other hand, he should be keenly aware that in orthodontics he is dealing with a problem that calls for subtleties of judgment in practice that cannot possibly be estimated on a purely scientific basis. If successful, he has acquired a rare gift which is particularly denied to those of an ultrascientific

turn of mind. He is always willing, however, to listen patiently and at length to any of the schemes which may bring decisions within the range of scientific appraisal. It is unfortunate when these are presented by men with little, if any, practical experience who make impressions on the specialty with bewildering statistical figures and complicated graphs which divert the mind from the main issues but in themselves offer no solution to the problems.

NATURAL OCCLUSIONS VERSUS SATISFACTORY OCCLUSIONS

Unless something definitely pathologic is present, the resultant combinations of component elements of a dental occlusion are both natural and normal for the specific individual. These combinations are only very rarely ideal, however, and in the majority of cases they are far from being satisfactory.

Nature rarely produces perfection in anything, least of all in anything as fantastically complex as the human organism. That is why there are so few Hollywood stars or mental geniuses in the world. Consequently, orthodontics is mainly the science and art of dealing with "unsatisfactory" genetic patterns. These genetic patterns can be dealt with successfully only by a keen awareness of some well-established scientific facts, some logical reasoning, a modicum of creative imagination, and the development and exercise of some rather rare natural or acquired talents.

Much of the confusion and waste of time and print presently plaguing orthodontics and impeding its progress could be easily averted by imposing a very simple rule to make it mandatory that every essayist present some personal clinical evidence that whatever he has to offer has some definite practical value.

As orthodontics is based on the infinite variations of the human organism and the uniqueness of the individual, it is obvious that the only method that can succeed is one in which the student can be led to develop in himself that spark of originality with which to cope with the ever-changing and unique set of circumstances and situations with which he will be beset and which he will have to face and solve at every step along his thorny path.

From the purely academic standpoint, there is no solution. From the frankly romantic and realistic standpoint, there is a solution and the wonder of it is how simple and clear it actually is. Science without creative imagination is dead.

CLASSIFICATIONS

Ever since orthodontics began to take form as a specialty and a so-called science, there has been a very natural and worth-while interest in trying to find a sound classification under which to group the different kinds of cases that are presented for treatment. These main attempts at classifications have made impacts that are worthy of some study and analysis:

Angle's classification: Three-dimensional bilateral plan, dentally oriented interrelation of parts; unrelated to other anatomic landmarks.

Simon's gnathostatics: Three-dimensional bilateral plan; cranially oriented interrelation of parts; externally located anatomic landmarks.

Cephalometrics: Two-dimensional unilateral plan; cranially oriented interrelation of parts; internally located anatomic landmarks.

Unfortunately, all classifications have been based on the false premise that it is possible to reduce infinite variation to the stuffy confines of any exactness of formulation.

As a residue of Angle's classification, on whose misinterpretations and lack of perspective untold orthodontic crimes have been committed, the terms Class I, II, and III may remain with us for some time to come, although the terms "neutroclusion," "mesioclusion," and "distoclusion" mean the same thing and are more descriptive.

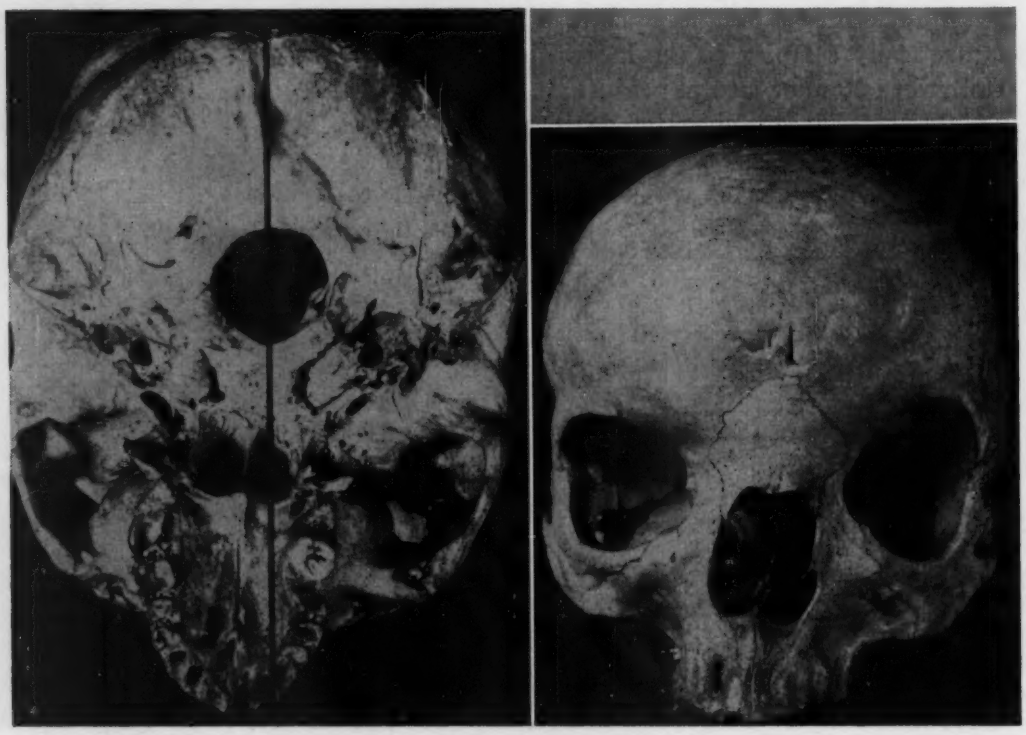


Fig. 16.—An example of extreme asymmetry in the human skull.

Simon's system of gnathostatics has the virtue of Teutonic thoroughness and meticulous attention to details which, unfortunately, are very much overshadowed by the larger issues involved. This is another case of losing sight of the woods because of the trees.

The diagnostic data obtainable by the present popular method of cephalometrics consist mainly of "two-dimensional" flat unilateral tracings of hemispheric cephalostatic radiographs. These may be satisfactory for physical anthropologists who are primarily interested in statistical averages on growth and development. They are hardly adequate, however, for orthodontists who are inescapably and forever dealing with peculiarities of the specific and unique,

during short periods of time, in which anatomy is only one of several equally important factors, and who obviously cannot very well get along without some scheme which also includes the dimensions of width and both of the lateral halves of the individual.

Orthodontics also can hardly accept as satisfactory any scheme that does not include the usual asymmetry of the individual. In other words, to be of value, a method of classification must provide information relative to the front aspect as well as both lateral sides of the individual.

Regardless of what scheme is used, all of the tissues under study are in a constant state of flux during normal developmental periods and much more so when anatomic structures and physiologic functions have been disturbed by extraneous forces that have been employed in the course of orthodontic therapy.

Fig. 17.—Compare this illustration for its total composite orthodontic diagnostic value with the present popular studies of "flat unilateral tracings of hemispheric cephalostatic radiographs." These latter have as much orientative accuracy, by comparison, as flat maps have compared to those on spherical atlases. The human skull is, in addition, notably asymmetrical. (From McCoy: Applied Orthodontics, Lea & Febiger.)

Orthodontics is very much in need of some scheme by which to determine changes that have taken place as a result of orthodontic treatment. To do this, it is necessary to have landmarks other than the interrelations of the teeth themselves. Angle's classification does not serve this purpose. Simon's bilateral, three-dimensional, externally located landmarks offer a fairly accurate means of determining these changes and would seem definitely more dependable than the internally located cranial landmarks of the cephalometric system which

cannot very well ignore the well-known asymmetry of the individual. It may well be that, in the last analysis, a simplified form of gnathostatics may prove the best means of coping with this ticklish problem.

The more complex a subject is, the more necessary it becomes to reduce its fundamental problems to the simplest possible concept.

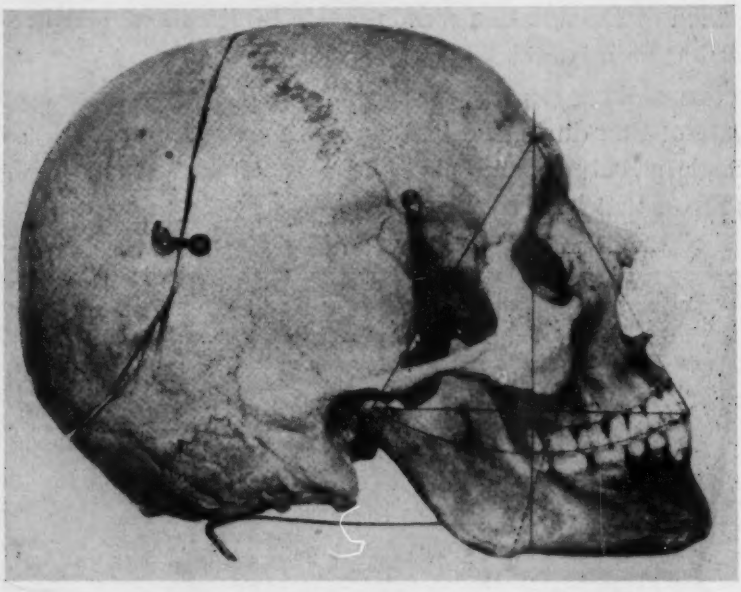


Fig. 18.

In orthodontics there are actually just three fundamental problems. These must be thought of simultaneously in order to form a single, composite mental picture. These three problems are as follows:

1. The size of the teeth and the amount and disposition of the bone in which to accommodate them.
2. The most desirable relationship of the mandible to the maxilla for each particular individual.
3. The proportion and relationship of the teeth to the skull and facial features which will produce the most pleasing esthetic appearances.

The actual condition of any occlusion is perfectly obvious to any careful observer and can be appraised fairly accurately by just looking at it from its different aspects. In its original static condition it can be recorded by plaster models, photographs, and radiographs.

An occlusion, with its myriad variations, can be judged *satisfactory* or *unsatisfactory,* as the case may be, on the basis of three fundamental qualities: structural balance, functional efficiency, and artistic harmony. In the evaluation of these qualities, everything depends on the opinions and judgment of the

clinician, for there are values of an ultrascientific or artistic nature which cannot be measured by scientific standards alone. An ideal dental occlusion is one in which these qualities combine perfectly with a complement of thirty-two perfectly proportioned teeth.

A careful study of the nature of these conditions—structural balance, functional efficiency, and esthetic harmony—will point to the fact that they constitute in themselves a natural classification for malocclusions, since they comprise the basic problems upon which decisions for treatment must be made.

These three conditions, studied separately, will reveal the factors which must be considered, the information that we have concerning them, methods for making decisions, and the means that may be logically and reasonably employed in treatment.

Orthodontics is too vast in its scope for any practicing orthodontist to be much more than superficially conversant with the basic sciences that are involved, but he can compare the scientific facts that have been gathered by eminently qualified persons with his own practical experiences and observations and reach some very logical conclusions as a working hypothesis for treatment. All true progress in orthodontics must come about in this way. The intelligent and clever clinician has no apology to make to his scientific collaborator.

The main object of this article is to endeavor to show that when we use a simple, logical process of reasoning, the facts that we already possess are sufficient to formulate a system of mental approach and a correlated method of treatment which will be quite adequate for practical purposes, without the necessity of resorting to the use of any fictions or preconceived theories.

The essence of orthodontic treatment lies in the fundamental facts that every case presents a unique combination of structural, functional and esthetic factors of extreme complexity which call for individual decisions, that treatment consists of making changes within the limitations of each case, and that these changes should be correlated at all times to the functional activities of mastication while they are being made. Orthodontics is a problem of dynamics from start to finish.

Structural balance depends upon a correct proportion of tooth substance to bone development when the latter has reached its growth limit, in order to permit a satisfactory alignment of the teeth. The amount of tooth substance inherited by the individual is determinable at an early age, but prior to maturity the amount of bone development to accommodate this tooth substance is not determinable by any scientific means as yet known or likely to be discovered in the future.

Brash says: "Such evidence as we have of the inheritance of face and jaw form, all points to the genetic constitution as a primary factor. There is evidence that extreme degrees of malrelations of the jaws and underdevelopment of the mandible are of the nature of real malformations and stand in relation to other regional malformations.

"There is no direct relation between the teeth and the sizes of the jaws. This is indeed the essence of the problem of irregularity and malocclusion."

In view of these facts, there is not only sufficient reason but an imperative necessity in many cases for making every conceivable form of compromise which the possibilities and limitations of individual factors determine as the final objective of treatment.

The clinician is, perforce, obliged to depend mainly upon his experience in clinical observation to make the tremendously important decisions that arise in cases of this kind. Although there is absolutely nothing definite to go by as to individual cases, much valuable information can be gathered through a painstaking study of the gross physical characteristics of the patient. The apical bases of the teeth are of the utmost significance in this respect, as only by their positions and relationships to the basal bone can the amount of actual tooth movement be reasonably estimated. Studies of models alone can be exceedingly misleading in this respect.

The bony substance of the jaws is composed of basal bone and alveolar process; these two substances vary greatly both in volume and in proportion to each other in different persons. This is one of the factors that account for the very great differences in resistance to tooth movement which exist between individuals and the obvious limitations of tooth movement in some cases.

The size and shape of the basal bone cannot be altered very materially by treatment, as this is determined predominantly by the genetic factor. The disposition of the alveolar process can be changed quite considerably by mechanical means; however, if the alveolar process is so changed as not to conform proportionately to the size and shape of the basal bone, no very permanent results can be expected. The possibilities and limitations of treatment are in most cases quite definitely determined by the shapes and sizes of the maxilla and the mandible and by the best compromise which can be made in the arrangement of the teeth to each other, depending on these factors. A large proportion of the failures in treatment have resulted from a disregard of these facts in an effort to obtain so-called ideal occlusions which in many cases are impossible of attainment.

In some cases the congenital absence of teeth, the extreme misplacement of certain teeth, and the influence of other factors are such that it is impossible to obtain an ideal occlusion or even a satisfactory occlusion. As long as the orthodontist has obtained the optimum that the individual factors permit, he has done his full duty by the patient. It is extremely difficult to determine just what this optimum is, for individual factors make fixed standards impossible. The application of ordinary common sense in a careful study of individual details, however, is often all that is needed to indicate quite clearly what may be estimated as the most desirable individual objective. If judgment is bad in this matter, no power on earth will prevent cases from being failures.

In order to make clear what all this means clinically, it is well at this time to consider four cases which required difficult and conflicting decisions. The case picked as representing an ideal occlusion, as shown in Figs. 19 and 20, was

not a natural ideal occlusion but was the result of orthodontic treatment. The natural occlusion of the case is shown in Figs. 21 and 22. This presented a difficult problem which, fortunately, was solved satisfactorily. It will be noted that the constriction or underdevelopment of the maxilla was such as to completely block out the canines. Under some very strong present concepts of the problem, this would have called for the consideration of some extractions. The actual problem was not simple. It will be noted that the patient has a well-developed mandible with ample room to accommodate all the teeth. It was decided to expand the maxillary arch and the result is shown in Figs. 19 and 20. The judicious enlargement of the arches with the proper type of technique has been so satisfactory and permanent over the years that my personal opinion is not in accordance with some of the present trends.

Fig. 19.

Fig. 20.

Figs. 19 and 20.—Ideal occlusion with esthetic harmony.

The second case to be considered, shown in Figs. 23 and 24, presents a problem for every orthodontist to consider carefully before starting treatment. This case taught me a lesson that I have never forgotten. A friend who dabbled in orthodontics asked me, for heaven's sake, to take the case off his hands as he could not make anything move after two years' treatment! I tried conservative treatment for a while, with the same result, and then came the awakening. This was one of those cases in which there was practically no alveolar bone and, as everyone should know, it is practically impossible to enlarge the arches in basal bone. Exodontists are fully aware of the troubles they may expect when they

are up against the problem of extracting teeth for patients with flat palates. The extraction of four premolars solved the main problem, although it will be noted

Fig. 21. Fig. 22.

Figs. 21 and 22.—The original occlusion of the beautiful young lady shown in Figs. 19 and 20. The treatment of this case called for an exceedingly difficult decision. The marked constriction of the maxilla with the complete blocking-out of the two canines will be noted. This was opposed to an exceedingly well-developed mandible with accommodations for a full complement of teeth with the incisors actually tilted lingually. The decision to attempt suffcient expansion to accommodate a full complement of teeth was made with the result shown in Figs. 19 and 20. This would have been quite impossible if the conditions shown in Figs. 23 and 24 had existed.

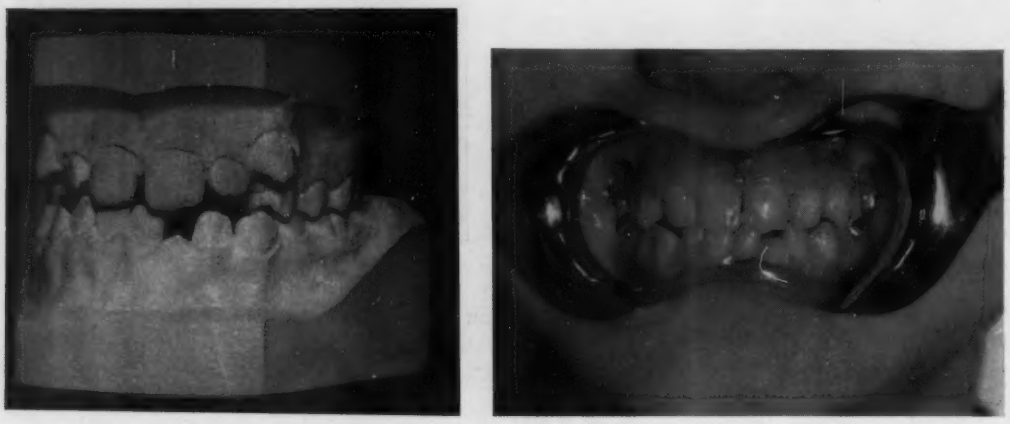


Fig. 23. Fig. 24.

Figs. 23 and 24.—Four premolars were extracted because the lack of alveolar process in proportion to basal bone made any other alternative impossible if a satisfactory alignment of the teeth was to be obtained. Note the transposition of a mandibular canine and a lateral incisor.

that there is still the matter of a complete transposition of a mandibular canine and lateral incisor. This may come under the heading of one of Hooten's "meaningless anatomical" variations. It was left as it was.

Fig. 25.

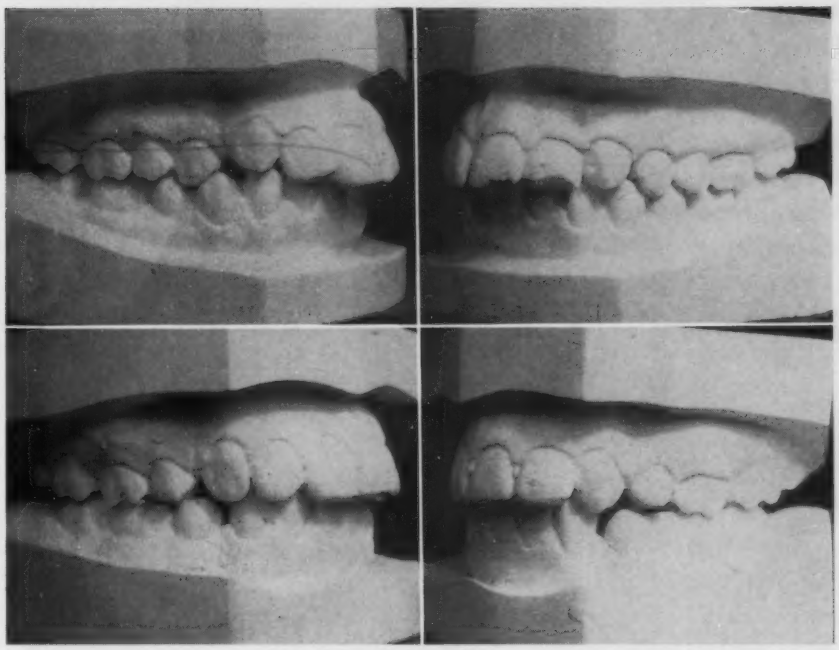


Fig. 26.

Fig. 27.

Figs. 25 to 27.—Four premolars were extracted, notwithstanding the fact that there was ample bony substance to accommodate a full complement of teeth. This was done for purely esthetic reasons. Fig. 25 shows the original condition, and Fig. 26 shows the present condition with four premolars extracted. In Fig. 27 are some candid shots of the patient showing the proportion of tooth substance to facial balance.

The third case to be considered is shown in Figs. 25, 26, and 27. It will be noted in the original models that there was more than enough room for all the teeth, however, after all the adjustments were made to produce practically an ideal occlusion from the standpoint of structural balance and functional efficiency, there remained an unsatisfactory condition—the patient presented a very displeasing appearance when she opened her mouth to laugh. After the problem was discussed fully, with the patient's grandfather, a very superior practicing dentist, four premolars were extracted purely for esthetic reasons. Candid camera shots, as shown in the final result, are far superior to posed photographs in helping the orthodontist make decisions on this very subtle artistic problem.

Fig. 28.

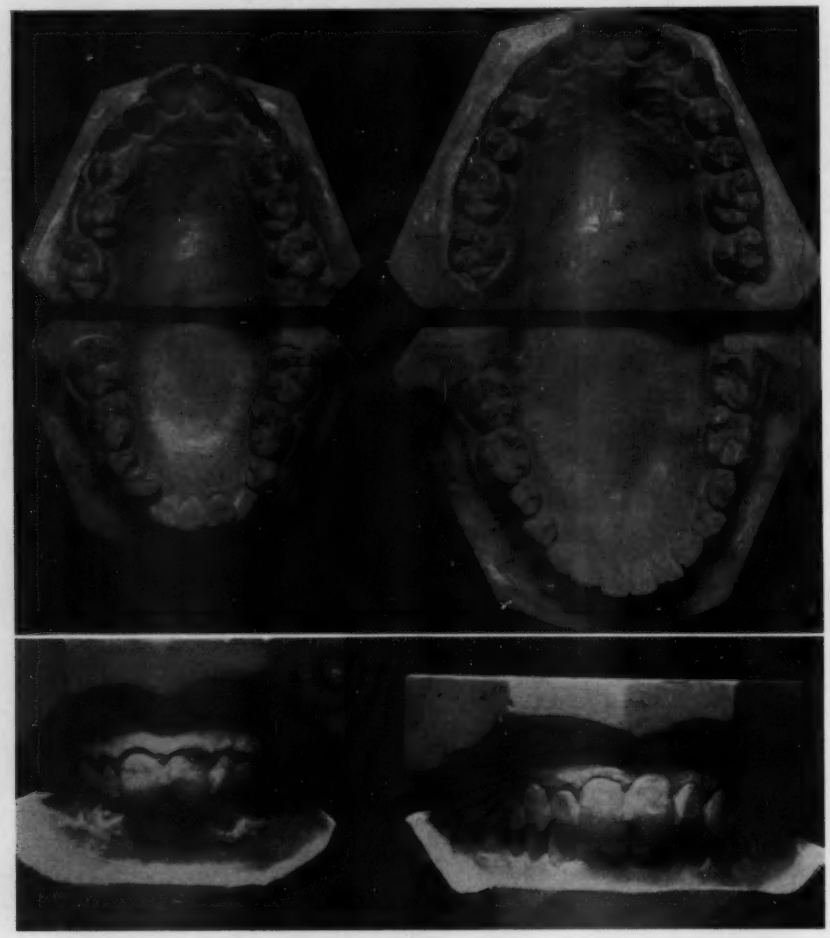


Fig. 29.

The fourth case, shown in Figs. 28 to 31, is one in which considerable expansion of both arches was resorted to in treatment. The first facial photograph (Fig. 30) shows the result at the end of treatment. The candid shots taken at the time this article was prepared (Fig. 31) show the present condition, twenty-six years after treatment. This patient is the wife of a successful dentist.

Fig. 30.

A. *B.*

C. *D.*

Fig. 31.—Snapshots of patient shown in Fig. 30, twenty-six years after work was completed.

In many cases, a satisfactory structural balance can be obtained only by the extraction of teeth. This is sound, scientifically and artistically, and in some cases it is a categoric necessity.

FUNCTIONAL EFFICIENCY

Functional efficiency depends upon a correct relationship of the teeth to each other and their orientation to the skull as a whole to permit a satisfactory excursion of the mandible in the function of mastication. The ideal positions of the teeth with respect to each other are well known and accepted, but their positions relative to the skull are still quite hazy.

The positions of the teeth in relation to the skull have sagittal, anteroposterior, and vertical dimensions. What the composite of these three should be in relation to the skull is as yet problematical, but it is logical to infer that it should be quite as variable as the characteristics of the individual himself. Of the three dimensions, it is obvious that the sagittal positions of the teeth should conform as nearly as possible to the median sagittal plane of the skull. To determine this median sagittal plane, however, is difficult if not impossible. Figs. 16 and 17 show this difficulty. This is not vital, either for functional efficiency or for esthetic reasons, and in most cases it cannot be altered to conform to any such ideal by purely intraoral forces. It is quite obvious that it should seldom, if ever, be desirable to employ extraoral force for this purpose. The same argument holds for the other two planes.

Nature herself does not seem to adhere to any mathematical precision in producing her individual specimens, so why should an orthodontist concern himself too seriously about such matters? Of the many theories on the subject of orientation, it would seem that an arrangement which conforms to the curve of an arc or segment of a sphere seems about as logical as any, as this arrangement is the most efficient from the standpoint of function and appears to be the most pleasing from the standpoint of esthetics.

When the main problem is a question of the relationship of the jaws to each other, the question is, to a great extent, determined from the functional standpoint by the possibilities and limitations of the psychic reactions and muscular control of the patient. The world is full of examples of persons who have completely changed their physical characteristics or endowments by sheer will to do so. The ability to change the relationship of the jaws to each other is by comparison, one of the easiest changes that can be made in the human anatomy and is best accomplished by an inspired desire to do so on the part of the patient, and the seed of this desire can be planted by the orthodontist. The orthodontist who fails to realize this throws away one of the greatest means of treatment. It is desirable in most cases, however, to make some alterations in the position of the teeth so that this change can be accomplished with the greatest ease, as the patient will always function naturally in the position of greatest comfort. A study of the functions of the patient and the disposition of the teeth will usually disclose what these changes should be with such clarity that they are often of almost ridiculous ease of detection. The use of appliances to act as reminders to alter function is of the greatest value.

A great deal has been written on the subject of orientation of the teeth and jaws to the cranium. In order to make scientific comparisons, the most stable bony landmarks have been selected and some very interesting unilateral comparative graphs have been made on flat surfaces during development and also before and after treatment. Some of these changes appear extremely plausible, but in most cases they represent only a part of the picture. The position of the mandible to the skull is a three-point suspension mechanism involving the two condyles and the opposition of the teeth. The three-point suspension mechanism is used to attach motors to automobile frames because it permits an infinite number of movements in their relationship to the frames. The movements and relations of the mandible to the skull are also infinite in number.

It is difficult, if not impossible, to x-ray a temporomandibular articulation accurately from a flat lateral angle. There are two condyles to be considered, however, and from a lateral view the condyles and the sella turcica, as a bony landmark, are at different distances anteroposteriorly from the x-ray machine. In order to make comparisons of actual value, it is necessary to make three-dimensional pictures including both condyles and the bony landmarks, all of them located at different three-dimensional positions in space. This imposes such great difficulties of execution that it is of dubious practical value in an organism that is undergoing change.

The problem in itself is such a vital one to the orthodontist that there is a crying need for a simpler and more practical method of determining the actual changes which take place when intermaxillary force, for example, is employed.

The use of intermaxillary elastics is one of the greatest aids in treatment, but these elastics can also produce disastrous results if unwisely employed.

ARTISTIC HARMONY

Artistic harmony is a matter of proportion in the shape, size, and orientation of the dental organs as a whole in their relationship to the other facial factors. Beauty is indefinable, but one of its main attributes is a correct proportion of its component elements. This is an artistic problem of such a subtle nature that it is doubtful that its objectives can ever be definitely measured and estimated in scientific terms for orthodontic purposes.

Here again the orthodontist is confronted with the limitless combinations which the component elements of an entire head and face are capable of producing. It is not only desirable but absolutely necessary at times to make every conceivable compromise which structure and function will permit in order to obtain the most desirable results. Bony anatomic landmarks are purely relative in value and are not much help from the artistic standpoint which, of necessity, must include all the soft tissues of the face with all their peculiarities of size and form. In some cases that have come under my own observation the structural balance and the functional efficiency could be considered satisfactory, but the artistic harmony was anything but satisfactory and offered problems of the utmost difficulty of solution.

In the actual field of orthodontic practice, with the inevitable heat and turmoil of action, a successful orthodontist must have several hundred cases under treatment subject to his personal, clinical judgment. It is absolutely necessary, therefore, that he should have a broad comprehensive diagnostic basis on which to make decisions in treatment on long-range objectives as well as immediate technical details which must be made quickly and with a fair degree of accuracy.

This leads directly to a consideration of the all-important matter of having constantly and immediately at hand a means for evaluating in one composite and all-inclusive picture the whole combination of component factors for purposes of diagnosis and treatment. This sounds preposterous, but it is inevitable. Fortunately there is a basis, so disarming in its simplicity as to undoubtedly elicit nothing but scorn from the ultra-scientifically minded theorists and yet so obvious and so all-inclusive in its capacity to envision the whole problem with its attendant details at a glance that it should be the joy and delight of every creatively minded clinician.

For over twenty years, repeated over and over again in numerous published papers, this simple and direct method of approach has been suggested and presented in concrete form. It has the essential virtue of being applicable to infinite variation.

This same simple method of approach is repeated here, not as a suggestion but as a challenge to anyone who can suggest a better means of approaching this all-important question.

The value of a single idea can never be overestimated. It has been shown again and again that one good idea is often sufficient to alter the whole course of human events. Fortunately, for the benefit of orthodontics, a distinguished orthodontist from Boston had a good idea.

THE POSITION OF MECHANICAL ADVANTAGE, OCCLUSAL PREFERENCE, OR OPTIMUM OCCLUSAL RELATION

An orthodontist must, of necessity, visualize what he wants to do. He should be able to see clearly, from every angle and viewpoint, the exact status of a condition as it is in its entirety and to compare this with a more desirable arrangement which, in his imagination and judgment, is possible of attainment by means of orthodontic procedures.

An orthodontist may well ask, "What or where is this vantage point from which the whole panorama may be scanned?" He will do well to not only think about this but, if it is once accepted by him, to give it priority over every other single thought connected with the clinical practice of orthodontics.

In my opinion, Dr. Alfred P. Rogers was the fortunate man who indicated the nearest approach to this vantage point when he coined a term in connection with his contributions to myofunctional therapy. That it had anything to do with myofunctional therapy is purely incidental, whether Dr. Rogers realizes the far-reaching importance of his basic concept or not.

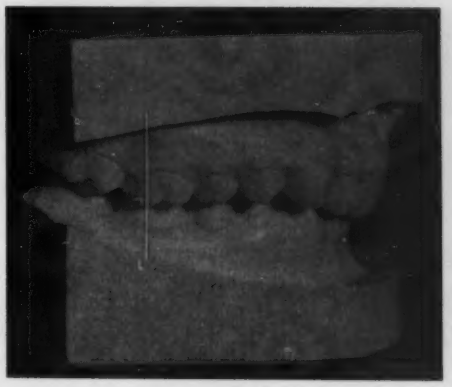


Fig. 32.

Fig. 33.

Fig. 32.—Model of case shown in Fig. 33.

Fig. 33.—Biting in position of "occlusal advantage," giving a true picture of proportion, relation, and orientation.

Fig. 34.

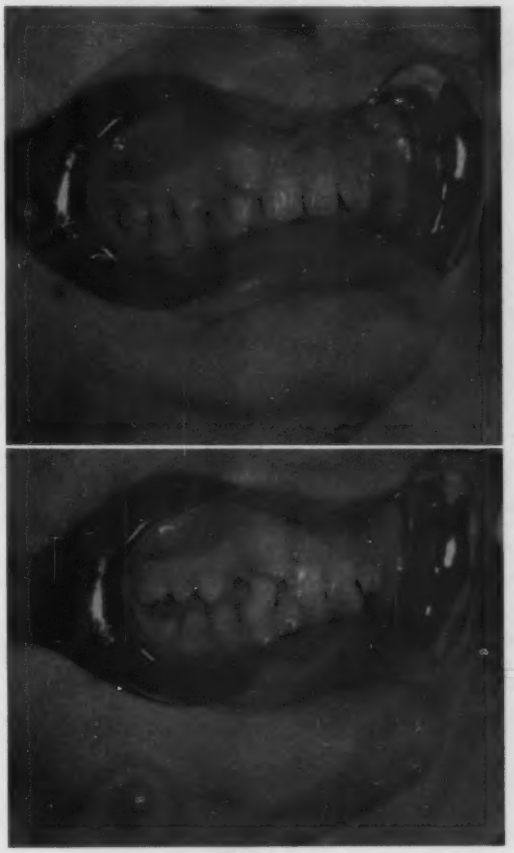
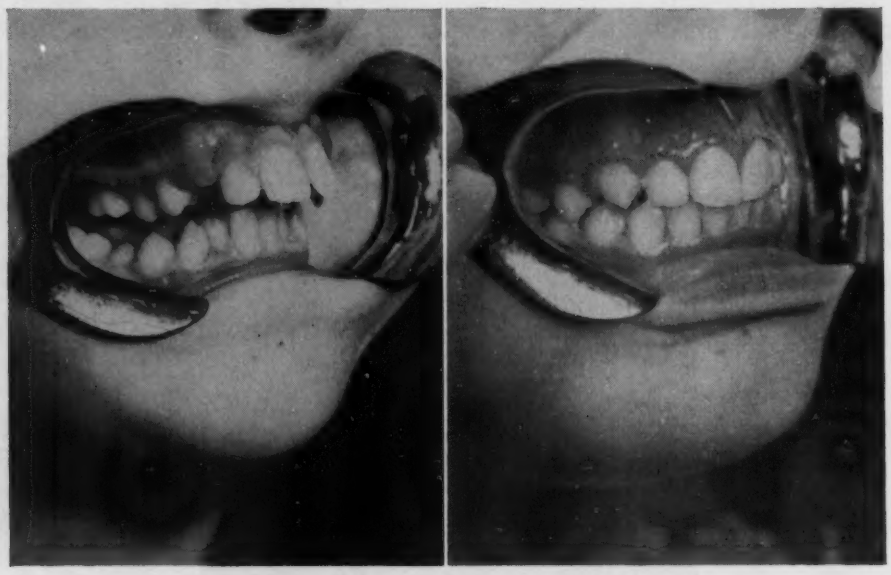


Fig. 35.

Fig. 34.—Natural position of malocclusion.

Fig. 35.—Teeth in Fig. 34 biting in position of occlusal advantage. Comparative photographs like this convey a much truer record of the "living realities" than can be obtained from models, whether they be made gnathostatically or not.

Rogers' idea consisted of directing the patients to place their jaws in the position which, visualizing the result at the end of treatment, seems the most desirable from the standpoint of function and esthetics. This is the simplest and most direct method of visualizing in their entirety the changes to be contemplated. He called this the position of "mechanical advantage." The term "optimum occlusal relation" might be more descriptive and specific. We might compromise with "occlusal preference." Whatever term is used, however, the important question is; "What means have we to determine exactly what this position is? In actuality, it is of necessity an arbitrary position, based entirely on the judgment of the clinician. It can be one of many, but again it should be the one which all the factors of the case indicate as the most desirable from the objective standpoint of structural balance, functional efficiency, and esthetic harmony in the finished result.



A. *B.*

Fig. 36.—*A*, Initial study of the position of mechanical advantage or optimal occlusal relation. Three-dimensional bilateral study of structure, function, and esthetic proportions and relations. *B*, Results of treatment.

As with every phase of orthodontics, this is subject to infinite variation, judgment on which can be tempered only by common sense and artistic feeling plus the ability of the clinician to estimate from past experience the limits to which the means at his command may be relied upon to effect the changes which seem most desirable. The treatment of a case in its perfection, like any form of art, can only be a matter of sheer genius. Figs. 32 to 35 show two patients biting in natural occlusion and in their positions of occlusal advantage. A thousand different cases will show a thousand different pictures. A study of models alone conveys no idea of what this position may be and, per se, may be very misleading as to what should be done. Figs 36 to 40 show the positions of "occlusal preference" before and after treatment.

Fig. 37.

Fig. 38. Fig. 39.

Figs. 38 and 39.—Occlusion and facial balance of case shown in Fig. 36 after treatment.

A careful study of the position of occlusal advantage not only clarifies the problems of the individual but also suggests the therapeutic means best suited to accomplish the desired changes.

As treatment of every case proceeds, like every other vital activity, to its final objectives in a series of correlated steps, it is very seldom, if ever, indicated that the same methods or appliances should be used for the entire treatment of a case any more than it is sensible to use the same club for an entire round of golf. The choice of appliances depends, therefore, on the orthodontist's basic philosophy of the subject.

Fig. 40.—Natural occlusion, position of occlusal advantage, and occlusion after treatment.

Comparing the position of natural occlusion with the position of mechanical advantage or optimum occlusal relation probably reduces to a single composite, all-inclusive picture all the factors that must be taken into consideration in studying each individual case more quickly and accurately than any other means as yet devised. Models cannot convey any idea of what this may be and, if studied by themselves, may lead to some very erroneous decisions both in final objectives and in the selection of means to obtain the desired results. This can never be reduced to an exact science; therefore, the more the elements of art are employed, the better for all concerned.

At this point any one may well ask: "Does this mean that all the scientific problems involved in orthodontics, from anthropology down to the living patient himself, can be answered by one glance at an admittedly arbitrary position of the jaws called occlusal advantage?" Naturally, this appears completely preposterous, and the answer is; "Of course not." Yet, until someone suggests something better, I think that from a purely practical standpoint it is the best we can do, and that to a great extent it is quite adequate. The reason for this is that science alone is completely helpless to furnish the concrete, practical answers that we need to accomplish our purposes, and we must employ methods and faculties of an ultrascientific nature. There is nothing strange or unusual about this. We do it every day of our lives in many of our activities which are utterly incomprehensible in their innate complexities and yet whose exercise we think nothing of because they have become commonplace through long practice of acquired skills.

All the scientific knowledge in the world is as completely useless by itself to a practicing orthodontist as it is to a cowboy engaged in breaking an untamed broncho. Both are engaged in efforts to induce organic tissues to function in manners that were not intended in the original plans of Nature.

(This article will be concluded in the next issue of the Journal.)

A careful study of the position of occlusal advantage not only clarifies the problems of the individual but also suggests the therapeutic means best suited to accomplish the desired changes.

As treatment of every case proceeds, like every other vital activity, to its final objectives in a series of correlated steps, it is very seldom, if ever, indicated that the same methods or appliances should be used for the entire treatment of a case any more than it is sensible to use the same club for an entire round of golf. The choice of appliances depends, therefore, on the orthodontist's basic philosophy of the subject.

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Orthodontic Profiles

ALBERT H. KETCHAM

ONE of the last of a breed of strong, willful, and purposeful men who left an indelible mark on the early history of orthodontics was Albert H. Ketcham. Born in Whiting, Vermont, on Aug. 3, 1870, he was educated at Vermont Academy and Boston Dental School, where he received his dental degree in 1892. In 1894 he was married in Boston to Mary E. Hickson, who bore him two children—a son, Arthur C., and a daughter, May G. A second marriage, to Flora B. Smith in Denver, Colorado, in 1923, brought him much happiness in his rather troubled and turbulent later years.

Dr. Ketcham's career as a dentist received an early setback when tuberculosis almost claimed him as a victim, and he came to Colorado at the turn of the century more dead than alive. He grew to love the West, not only because it brought him back to health but also because it offered wide-open spaces in which he had room to roam and to engage in the hunting and fishing that he loved. His indomitable will speeded his recovery to where he could resume practice in a limited way. He fitted an office in Meeker, Colorado, with a saddle rigged as a dental chair to make his cowboy patients feel more at ease.

As his recovery became more complete, his creative energy demanded fuller expression. He moved to Denver where for a while he specialized in periodontics. This offered no great challenge to him, however. He began to realize that the field of orthodontics held greater potential for health services of unlimited challenge in an age group that could appreciate them for a whole lifetime. Therefore, in 1902, he became a student of Edward H. Angle, and the profession of orthodontics received one of its most dedicated leaders.

Although he was dogged by more than his share of physical handicaps, Dr. Ketcham was essentially strong physically. His large, raw-boned frame was topped by a mass of unruly hair that seemed to give him a rough-and-ready schoolboy alertness. His slow, studied speech and his eyes peering through thick lenses bespoke of gentleness, thoughtfulness, and understanding. His uneven, somewhat lurching, walk hinted at uncompromising but unheeded pains and made his actions pointedly purposeful. Thus, he instilled confidence in those who met him. To him friendships were highly prized but not altogether priceless. He made enemies by expressing his thoughts clearly and often bluntly. His opinions on any question were always arrived at by much reading, discussion, and serious thinking, and from these opinions he did not retreat readily. His was an investigative mind that probed deeply into new or controversial

problems, and so, although he and Dr. Angle traveled the same path in the same direction, they never could travel serenely side by side. Each did his own thinking.

This was the man who served as president of the American Society of Orthodontists, as the A. A. O. was then known, in the 1928-1929 term. Under his leadership much was accomplished to strengthen that organization as a national body. At the 1929 meeting in Estes Park, Colorado, Dr. Ketcham called attention to the fact that there were members of the American Society of Orthodontists who were not members of the American Dental Association. In order

ALBERT H. KETCHAM

to remedy this condition, the Society passed a resolution requesting all the members of the A. S. O. to become members of their local, state, and national dental societies. The requirements for active membership in the A. S. O. were changed, making membership in the American Dental Association compulsory. Also, at Dr. Ketcham's suggestion, the Education Committee was established as a standing committee of five members, each serving for five years, and a Committee on Nomenclature was created.

Probably the project closest to his heart, and one on which he expended much of his energy, was the formation of the American Board of Orthodontics. Physician friends who were members of the American Board of Ophthalmology (the first medical certifying board) and the American Board of Otolaryngology gave him many of the ideas that formed the basic pattern of the American Board of Orthodontics. Because he felt that orthodontics needed a certifying board, he recommended its formation at the Estes Park meeting, and this recommendation was immediately and unanimously adopted by the Society. The members of the first Board were nominated by the Executive Committee and elected by the Society. The American Board of Orthodontics was incorporated under the laws of the State of Illinois in 1930, and Dr. Ketcham served as its first president.

Editorializing on the Estes Park meeting of the American Society of Orthodontists, Martin Dewey stated: "It is our belief that the meeting of the A. S. O. under the guidance of Dr. Ketcham has accomplished the most constructive work in the history of the Society."

Albert Ketcham loved and was completely devoted to his profession. The last paragraph of his president's address makes this clear. He said: "In closing, let me say that we may make our lives greatly useful in our chosen specialty, that the knowledge of orthodontia may advance apace and be the dominant factor in the welfare of humanity that it can and should be. Then the many and far-reaching benefits of orthodontia may be enjoyed by the great host of children to whom it will be such a priceless boon."

His scientific contributions were many and varied, and all were aimed at the betterment of his profession. His case reports of both failures and successes were scrupulously presented in the hope that they might in some way enlarge the scope of orthodontic possibilities. He was an idealist, and it pained him to recognize limitations. Yet, his most exhaustive work tended at times to make him seek compromise. This was his extensive investigation on apical root resorption of vital permanent teeth. His two articles reporting this study stunned the orthodontic profession and did much to lend greater emphasis to the biologic aspect in orthodontic thinking.

Spurred by his findings, he instigated a research program at the Hooper Foundation for Medical Research at the University of California with Dr. John A. Marshall in charge. The necessary operating funds were raised by voluntary contributions from members of the American Society of Orthodontists.

As one of the recognized leaders in his field, he was besieged by requests from men seeking orthodontic education to serve as a preceptor. Through the years many men came under his strict supervision in his office. As a teacher, he was characteristically thorough, giving time that seemed unavailable to instill in his students proper procedure and concept. He never felt that his duties as an instructor had ended, for he corresponded voluminously with those who left his direct supervision. He labored, sometimes beyond reason, to effect exact wording in his letters so that there would be no doubt as to his thoughts.

When his waking hours were not taken up with the serious business of orthodontics, they were plunged deeply into his hobbies of hunting, fishing, and general enjoyment of his Rocky Mountain high country. Since he could never have been accused of having any semblance of a split personality, his behavior away from the office was also ever meticulous. As the hunting or fishing season approached, he laid plans and checked equipment carefully. For him, time, even leisure time, was too precious to be allowed to escape without taking the fullest advantage of it.

His favorite summertime retreat was a rustic cabin high in the hills not too far from Denver. Here, in the cool, pine-scented air that separated the clear blue sky from the equally clear blue waters of his trout haven known as Lake Edith, he could relax completely. He could relax in the swivel chair that he had mounted in his boat as he expertly cast a fly to where he was sure a hungry trout was waiting for it. The trout must have liked the flies he used or the way he presented them, for he consistently came back with more than the others who attempted to lure the wary creatures.

Driving his uninitiated lowland friends to Lake Edith, which was at an altitude of over 10,000 feet, allowed him to exercise a mild form of practical joking that he enjoyed. The narrow, precarious roads with sides that dropped vertically several hundred feet usually terrorized his passengers. He delighted in adding to this terror by warning them that they all might have to help push the car up the last mile. This threat seemed about to become a reality moments before the car finally scrambled from its precipitous roadway and rolled peacefully into the hushed stillness of what he considered God's country.

Dr. Ketcham had friends from all walks of life—from machinists who helped him devise special equipment at his office to college professors with whom he often collaborated on varied subjects, and from cowboys to artists. People remembered him even though sometimes they were in contact with him for only a short time. Dr. H. C. Pollock, editor of the AMERICAN JOURNAL OF ORTHODONTICS, tells of having lunch recently with Dr. R. C. Seibert who told him of a pack trip he had made fifty years ago into the remote roadless Mesa Verde country of Colorado. There he met a Denver dentist whose name he could not recall, but he remembered that he wore thick-lensed glasses, was a meticulous chap, and was tremendously interested in digging around the ancient ruins. Dr. Pollock knew immediately that the man in question could be none other than Albert Ketcham, as proved to be the case.

This man who was so unforgettable had two great loves. First and foremost was his chosen profession of orthodontics, and second was hunting and fishing. In each he was an authority and an expert. Despite physical handicaps that would have discouraged lesser men, he expended more meaningful energy in each of these than did most of his more robust colleagues. This was Dr. Albert H. Ketcham, who died on Dec. 5, 1935.

George H. Siersma.

Editorial

BACKGROUND AND MANUSCRIPT

IF LETTERS to the editor are any criterion, there is now much demand for information about the status of the orthodontic specialty. A popular lay writer requests information, for instance, as to what he should read in order to become familiar with the merits of orthodontics. A well-known labor leader asks for information with the idea in mind of adding orthodontics to comprehensive health insurance as a part of its dental service. An army officer asks where (in America) the European functional type of orthodontic treatment can be secured.*

Increasingly frequent inquiries seem to add up to the obvious conclusion that more and more persons are becoming interested in the merits of orthodontic treatment. There is, however, an obvious undercurrent of mental speculation as to why this treatment is such a big undertaking and why it is so expensive. A few persons in this field have been working for some years in the hope of being able to simplify orthodontic treatment, at least to some extent.

In this issue of the JOURNAL, you may read the first part of an article by an author who has been working for years with the thought in mind that, by using the appliance to fit the problem at hand rather than using only one "routine" for all cases, he could bring about some simplification in treatment.

In introducing essayist Andrew F. Jackson of Philadelphia, Pennsylvania, at the twenty-fifth annual meeting of the Pacific Coast Society of Orthodontists in February, 1958, James D. McCoy of Beverly Hills, California, said, among other things: "Time and experience are great teachers and while some of us had to learn things the hard way, we did learn them, and a man like our guest essayist of this morning, who brought to our specialty a scientifically trained and cultured mind, has left a rich heritage for some of you who are relatively new to orthodontics."

Dr. Andrew Francis Jackson came into orthodontics at the time of World War I, under the tutelage of Dr. William G. Law of Berlin, Germany, who was one of Dr. Edward H. Angle's early students. Previous to the outbreak of World War I, Dr. Law had been conducting a highly successful orthodontic practice in Berlin. Being, by nature, a colorful and forceful personality, Dr. Law was one of the main forces instrumental in promoting the

*From an American army officer returned from the European Occupation Troops.

formation of the European Orthodontic Society and was duly elected its first president for the first two years of its existence. Returning to the United States at the outbreak of the War, he was free for a few months to engage in his favorite pastime of giving private orthodontic instruction. He did this, in Dr. Jackson's case, by spending several months in Dr. Jackson's private office.

Dr. Jackson was born in Concepción, Chile, South America, of Scotch-Welsh ancestry. He received his preliminary education in American schools in Chile and entered the Dental School of the University of Pennsylvania in 1901, graduating in the class of 1904. For this reason, he is bilingual (Spanish and English) and has, in addition, a working knowledge of French and a smattering of Portuguese. This has enabled him to be a valuable asset in Pan-American relations, in which he has been active for many years. He was awarded a diploma in orthodontics by the University of Glasgow, and honorary membership in the British Dental Society and in the American Dental Society of Europe. In addition to that, he was awarded an honorary degree from The Royal College of Surgeons in England; he read the Tomes lectures before the assembled group at the time that degree was conferred. His record reveals not only that he has been one of the erudite, serious students of orthodontics but also that as an avocation, he established an enviable reputation as an amateur actor and painter in Swarthmore, Pennsylvania (a suburb of Philadelphia).

The current paper by Dr. Jackson was presented in February, 1958, before the Pacific Coast Society of Orthodontists in Santa Barbara, California. With some modifications, the same paper was subsequently presented before the Denver Summer Seminar in August, 1958.

The paper has interest because the author reflects a comprehensive knowledge of all departments of study. He is plainly familiar with the growing of peas in the monastery garden, from whence Mendel conceived the idea that made genetics one of the important modern sciences, and Dr. Jackson does not ignore that knowledge in applying it to his perspective of clinical practice.

The text reveals that Dr. Jackson is not without intimate knowledge of the work of Darwin on evolution. He is not uninformed concerning the work of Stockard, who, with orthodontist LeRoy Johnson, crossbred dogs at the Cornell Experimental Farm to find out something about the genetic and endocrine basis for differences in form and behavior patterns, particularly with respect to teeth and jaws, under conditions other than that of natural selection.

Dr. Jackson lays stress on the infinite variation of the bones and sinuses of the head and face, and his perspective is further revealed when he defines his subject as the "Science, Philosophy, and Art of Orthodontic Practice." He regards orthodontics as basically a biologic and zoologic proposition, the processes of which obtain in both health and disease and cannot be ignored or bypassed in a diagnosis and appraisal of the problem at hand.

You may or may not agree with Dr. Jackson in his views. Nevertheless, the evidence is clear that he is a skilled clinical orthodontist and that forty years of experience and careful study of the subject by one of orthodontics' best scholars and readers is well worth while.

You quickly sense in reading the Jackson article that he regards endocrines and genes as mightier than the cerebral cortex in the solution of the problem at hand and that his opinions are quite remote from those of other students of the problem.

One thing is certain, however: His practical clinical experience is exceeded by but few, if any, either living or dead.

H. C. P.

Forthcoming meetings of the American Association of Orthodontists:
1959—Statler Hotel, Detroit, Michigan, May 4 to 7.
1960—Shoreham Hotel, Washington, D. C., April 24 to 28.
1961—Denver, Colorado.
1962—Los Angeles, California.

Department of Orthodontic Abstracts and Reviews

Edited by
DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Stress and Strain in Bones: Their Relation to Fractures and Osteogenesis. By F. Gaynor Evans, Ph.D., Associate Professor of Anatomy, Wayne State University, College of Medicine, Detroit, Michigan. Springfield, Illinois, Charles C Thomas, 1957. Illustrated. 245 pages. Price, $6.50.

This volume attempts to present some of the more recent experimental work on stress and strain in bones and bone. Particular emphasis is placed on the relation of stress-strain phenomena to fractures and osteogenesis. There is much information of value to orthodontists who produce force on the jawbones. The following types of force are defined: tensile, compressive, and shearing. Stress and strain, so frequently coupled by orthodontists, are explained and their distinct features are illustrated. The terms defined and the principles discussed are those involved in the biomechanics of bones. The photoelectrics and "stress-coat" methods are explained. It appears that the use of wire resistance strain gauges connected with cathode ray oscilloscopes which have been used to study tensile and compressive strains in the bones of living dogs can be applied in the study of orthodontic changes in jawbones.

Mathematical analyses of cross sections of bones, a method frequently presented in the discussion of orthodontic force, are shown by Evans to be invalid because they assume an even distribution of force in the bone—"a condition," the author points out, "which rarely occurs in bone." Studies of stress and strain in the human mandible are mentioned. However, the relation of trajectorial force in the human mandible still remains to be investigated.

Evans sums up the chapter on "The Role of Stress and Strain in Bone Architecture" with the opinion that ". . . function, which may be in the nature of tensile or compressive stresses, is the real stimulus of bone formation and growth. The role of muscle action in the process is not clear."

Of special interest to orthodontists are the chapters on "The Effect of Stress on Bone Healing and Growth" and on "The Tensile, Compression and Shearing Strength of Bone." Those interested in the behavior of bone and bones under the application of force, and every orthodontist should be, will find this book rewarding reading and study.

J. A. S.

Change in the Profile of the Osseous Chin During Childhood. By Howard V. Meredith. *Am. J. Phys. Anthropol.* **15**: 247-252, 1957.

This report, based on longitudinal records that span one decade of postnatal life, pertains to the anterior profile of the mandible. The data are analyzed for variability at three childhood ages (4 years, 9 years, and 14 years) and for the amount of change during the interval between the age of 4 years and the age of 14 years.

This study included thirty-four American-born white children of northwest European ancestry and above average socioeconomic status. A profile roentgenogram of each subject's head was obtained at the ages of 4, 9, and 14 years. The exposures were made with the head maintained in the Higley positioner, the distance from the x-ray source to the midsagittal plane held constant at 150 cm., and the central x-ray passing through the acoustic meatuses.

The mandibular plane was oriented horizontally (Fig. 1, line XY). Two points along the anterior margin of the mandibular margin were located. The superior point, A, was the most anterior projection of the mandibular margin in the alveolar region. The inferior point, B, was the most anterior projection of the mandibular margin. A straight line was drawn connecting these two points. The measurement determined, C, was the *maximum perpendicular distance* from line AB to the anterior margin of the mandibular margin.

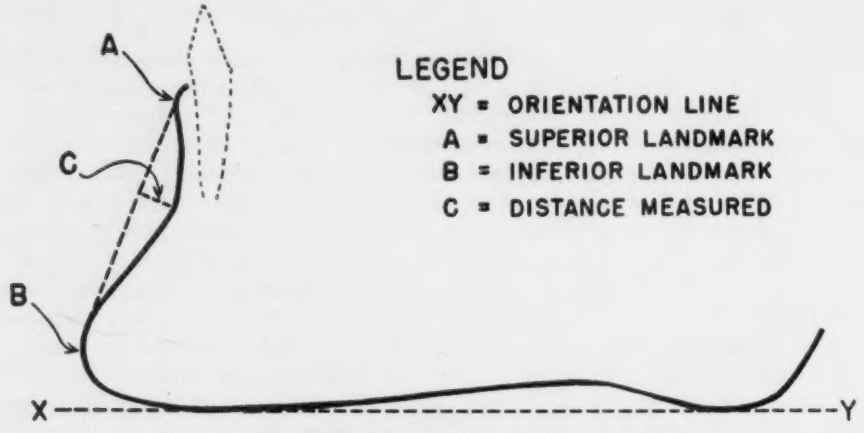

Fig. 1 Graphic representation of the method.

(From original of Fig. 1, Howard V. Meredith, Am. J. Phys. Anthropol. 15: 248, 1957.)

Sex differences were found to be insignificant; corresponding statistics in the columns for boys and for girls are similar throughout. The composite means for children of both sexes increase from 0.8 mm. at the age of 4 years, through 1.6 mm. at the age of 9 years, to 2.5 mm. at the age of 14 years.

At one end of the distribution of mandibular profiles for the age of 4 years, there is almost no anterior concavity. This is shown by the minimum value of 0.2 mm. The maximum expression of anterior concavity (''incurvatio mandibularis'') is markedly less among children 4 years of age than among children 14 years of age.

Change in the curvature of the anterior profile of the mandible during the postnatal decade from 4 to 14 years was found for every child studied and was much greater for some persons than for others. Change distributions, derived by subtracting each child's measurement at age 4 from his measurement at age 14, were observed. A maximum change is 2.6 mm.

During the decade investigated there is a progressive increase in anterior concavity of the mandible. Individual differences are illustrated with respect to profile of the osseous chin at selected ages and change in chin profile over the ten-year period of human ontogeny encompassed.

Quantitative Roentgenologic Studies on Changes in Mineral Content of Bone in Vivo. By Karl-Ake Omnell. From the Royal Dental School, Malms, and the Karolinska Institutet, Stockholm. Published as a Supplement (No. 148) to Acta Radiologica. Stockholm 2, Sweden, 1957. 86 pages. Illustrated. Price, Sw.K2.25.

This monograph presents an investigation on the theoretic background of the roentgenographic photometric method for quantitative analysis of bone salt in vivo and its application for studying mineral content changes in experimentally produced lesions in interalveolar septa in dogs. A valuable historical review is presented on the accuracy and methods for determining the mineral content of teeth and bones. An outline is included on the alternation of roentgen radiation in matter, and mass absorption coefficients of some elements are given for the energy range 15 to 100 kv.

The apparatus used permitted reproduction of the interrelationship between the positions of the roentgen tube, object, and film at different examinations. Quantitative studies are presented on changes in mineral content in interalveolar bone septa.

J. A. S.

News and Notes

American Board of Orthodontics

The next meeting of the American Board of Orthodontics will be held at the Statler Hotel in Detroit, Michigan, April 28 through May 2, 1959. Orthodontists who desire to be certified by the Board may obtain application blanks from the Secretary, Dr. Wendell L. Wylie, University of California School of Dentistry, The Medical Center, San Francisco 22, California.

Applications for acceptance at the Detroit meeting, leading to stipulation of examination requirements for the following year, must be filed before March 1, 1959. To be eligible, an applicant must have been an *active* member of the American Association of Orthodontists for at least two years.

Great Lakes Society of Orthodontists

The Great Lakes Society of Orthodontists will meet Nov. 2 to 5, 1958, in Pittsburgh, Pennsylvania. The program follows:

Monday, November 3

Society Breakfast and Opening Business Meeting.

Current Application of the Cephalometric Procedure. Robert M. Ricketts.

Can the Orthodontist Predict Facial Growth? Arthur H. Craven.

A Psychiatric Study of Certain Functions of the Mouth. T. L. Dehne.

An Evaluation of Preceptorship Training as Preparation for Specialization in Orthodontics. Stephen Hopkins.

President's Reception and Banquet.

Tuesday, November 4

Modern Trends in Orthodontic Therapy. Samuel J. Lewis.

Research and the Practicing Orthodontist. Edward J. Forrest.

Growth, Development, and Environment Influences in Orthodontic Treatment. Edward J. Forrest.

Society Luncheon for members, wives, and guests. (Speaker: Wilton Marion Krogman—"The Evil is Buried With the Bones.")

Tuesday afternoon will be left open for trips, shopping, or visiting the exhibits.

Table Clinics (Tuesday evening).

Wednesday, November 5

The Orthodontic Workshop. Robert E. Moyers.

The Begg Light Wire Technique—Observations and Experiences. Harold Kesling.

Business Meeting.

Adjournment.

Northeastern Society of Orthodontists

The next meeting of the Northeastern Society of Orthodontists will be held Nov. 3 and 4, 1958, at the Queen Elizabeth Hotel in Montreal, Quebec.

The newly elected officers of the Northeastern Society are as follows:

President: Walter R. Bedell
President-Elect: Wilbur J. Prezzano
Vice-President: Henry C. Beebe
Secretary-Treasurer: David Mossberg
Sectional Editor: Joseph D. Eby
Assistant Editor: Brainerd F. Swain
Historian: Leuman M. Waugh
Director: Norman L. Hillyer
Alternate: Richard Lowy

Kansas and Oklahoma Orthodontists Meet

At the fabulous Western Hills Lodge in the Sequoia State Park and the nearby 20,000 acre Fort Gibson Lake, the members of the Oklahoma Orthodontic Society were hosts to the orthodontists of Kansas. A number of wives and children were also present, arriving on Saturday for a short outing while their husbands and fathers attended the orthodontic meeting. Everyone enjoyed a long week end of relaxation and the pleasures offered by the facilities at the resort.

The meeting convened at the social and dinner hour on Sunday evening, where the visitors, members, and guests were made to feel at home with appropriate words of welcome by President George R. Webber. Each one in attendance was presented by the method of autointroduction. Everyone was well pleased and the sentiment was general that an occasional joint meeting was very appropriate, especially following the closing of school and prior to vacations. A short break in our office routine for a little outing at a choice meeting place is highly enjoyable, and Western Hills seems to qualify admirably as a place of meeting.

Following the dinner and upon the retirement of the family guests, the evening session ensued. On opening the session, President Webber called for a further consideration of the unfinished discussion at the previous meeting of the report of the Economics Committee, members of which are Earl C. Cunningham, Marion A. Flesher, and Harry H. Sorrels. The main subject for the evening's round-table discussion was a questionnaire covering the office management of orthodontic cases from the initial appointment to the completion of the case. One of the warmest discussions concerned the procedure followed in outlining the financial arrangement and the question of a flat fee versus a yearly basic fee. The advantages and disadvantages of each method were thoroughly presented by the leaders, after which the round-table operation ensued with almost everyone having part in the discussions. Many interesting points were mentioned with respect to the economic aspect and the patient-orthodontist relationship. These discussions are very interesting, stimulating, and most welcome for all concerned. On some other subjects, as with the preceding one, there are naturally differences of opinions. That is what makes our meetings more worth while. We have a broader understanding of the subject. The greater the differences, the more thoroughly the subject is explored. There seems to be a mutual understanding that "we agree to disagree agreeably." The prolonged overtime evening sessions are evidence of their interest. Of course, the scope of our economics is pretty much the study of our living in its broadest sense.

Following the breakfast on Monday morning, the program called for "Retention" as the subject for consideration, with Harold S. Born, Robert Knarr, and Levern Merrifield leading the round-table discussions. A variety of retainers were presented, including various

types of fixed and removable appliances and some with active features. Consideration was given as to when and how retainers should be worn, whether or not they should be worn at meals, etc. Equilibration and the "settling-in" of teeth during retention were discussed. A great many unique and interesting ideas and suggestions were offered. It was a very helpful study and emphasized the extreme importance of retention in the successful completion of a case. The members of the Kansas group entered fully into the discussions, and we were pleased to have them as our guests.

Orthodontists present from Kansas were J. Victor Benton, R. E. Olson, and John H. Rogers, Wichita; Joe T. Casper, Jr., R. H. Hamilton, and Ray Woodworth, Topeka; Howard H. Dukes and John W. Richmond, Kansas City; Leo A. Rogers, Hutchinson; Clyde F. Schuman, El Dorado; and Gordon L. Teall, Hiawatha.

Oklahoma orthodontists attending were Robert H. Knarr, George E. Mindeman, Fred W. Sims, Hugh Sims, and Joe T. Reece, Tulsa; Earl R. Cunningham, Marion A. Flesher, William N. Flesher, W. E. Flesher, Paul E. Plowman, and Harry S. Sorrels, Oklahoma City; Barrett R. Andrews, Lawton; Harold S. Born, Bartlesville; J. D. Hall, Muskogee; Levern Merrifield, Ponca City; and George R. Webber, Enid.

The only short item of the meeting was the business meeting. Of special importance was the creation of the Honorary Life Membership. Dr. Tullie Wallace Sorrels, who recently retired from active practice, was the first member of the Oklahoma Orthodontic Society to receive this honor.

It was voted to send the reprints from *Coronet* magazine and *Consumer Reports* to all Oklahoma dentists in the interest of dentistry in general, but more especially in the interest of dentistry for children.

Another joint meeting of the Oklahoma orthodontists and the Kansas orthodontists was arranged for June 7 and 8, 1959, at Western Hills.

With further congratulations by all to all for a profitable program and an enjoyable week end, the meeting closed with hearty handshakes and well wishes until we meet again.

W. E. F.

U. S. Department of Health, Education, and Welfare

One hundred thirty-five medical, dental, engineering, science, nurse, and veterinary students from 120 approved four-year professional schools have spent the summer months in United States Public Health Service facilities under the Service's year-round training program.

The program is known as COSTEP (Commissioned Officer Student Training and Extern Program). Assignments under COSTEP are open each year to medical, dental, engineering, science, nurse, and veterinary students who complete either their second or third year of professional education on or before July 1 and who are interested in becoming Reserve Officers in the Service's Commissioned Corps.

Students selected for COSTEP are offered commissions in grades equivalent to those held by officers in the Armed Forces. They are then placed on active duty for a period not to exceed 120 days. Opportunities for either medical or dental internships or active duty upon graduation are also available to qualified students.

The largest number of students under COSTEP are employed by the Service during the summer months, but since the program is open, the year-round students attending schools operating on the quarter system can apply throughout the year.

The purpose of COSTEP is fourfold: (1) to stimulate the interest of promising students in careers in the Public Health Service, principal health agency of the Federal Government; (2) to enable students to further their professional knowledge while gainfully employed; (3) to give students an opportunity to increase their understanding of and interest in the functions of government and independent public health agencies; (4) to provide the Service with competent help during the vacation months.

The nature and location of assignments under COSTEP are, in general, as follows:

1. Laboratory assignments in medical research programs at the National Institutes of Health, Bethesda, Maryland, and the Communicable Disease Center, Atlanta, Georgia.
2. Clinical clerkships at Public Health Service hospitals and other medical facilities in the United States and Alaska (usually open to students with three years of professional education).
3. Field assignments in public health activities in a number of places throughout the United States.

Dental Care Program for Dependents of Servicemen Recommended to Defense Department by Dental Advisory Committee for Medicare*

A recommendation to establish a dental care program for the three million dependents of military personnel was submitted to the Defense Department August 4 in a report prepared by the Dental Advisory Committee to the Office for Dependents' Medical Care (Medicare). Under the present Medicare program, dental care for dependents is limited to emergency treatment at military bases except in so-called remote areas and to certain surgical services in hospitals and private dental offices. The A. D. A. is on record recommending the development of a plan which would "cover the provision of dental care to dependents of military personnel." The eighteen-member Dental Advisory Committee was headed by Major General Paul I. Robinson, executive director of Medicare, and included three A. D. A. representatives, Dr. John P. Looby, of Philadelphia, member of the Council on Hospital Dental Service; Dr. C. E. Rutledge, of Richmond, California, chairman of the Judicial Council, and Dr. Rudolph H. Friedrich, of Chicago, secretary of the Council on Dental Health. The committee also included representatives of the military services, the Public Health Service, the insurance industry, and Blue Shield. The report was presented to Dr. Frank B. Berry, the assistant secretary of defense for health and medical affairs.

The committee, which sent questionnaires to 8,000 servicemen in the fifteen-month study, said that "comprehensive dental care is an integral part of basic health care and essential to health maintenance." It reported that dependents' dental care is an important factor in the decision of servicemen on re-enlistment. The program would include all dental care, exclusive of routine orthodontics. The recommendations included treatment of dependents by dental officers, within the limit of facilities, and inauguration of an extensive program of dependents' care by civilian dentists. "The dental care provided dependents in dental facilities of the uniformed services should in no way interfere with the primary mission of those facilities," the report said. Complete dental care, including orthodontics, would be made available in cases of cleft palate and other severe mouth and jaw abnormalities. "High priority to the care of children in order to develop the maximum preventive effect of early and regular dental care" was also advocated.

Notes of Interest

William J. Clauss, D.D.S., M.S., and William A. Heisel, D.D.S., M.S., announce their association in the practice of orthodontics at 1605 Fort St., Wyandotte, Michigan.

Frederick M. Keiper, D.D.S., announces the opening of his offices at 2533 Walnut St., Harrisburg, Pennsylvania, practice limited to orthodontics.

Lewis W. Robinson, D.D.S., announces that he has discontinued his office in Grove City, Pennsylvania, and is now located in Greenville, Pennsylvania, practice limited to orthodontics.

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*Excerpt from the *A. D. A. News Letter*, Aug. 15, 1958.

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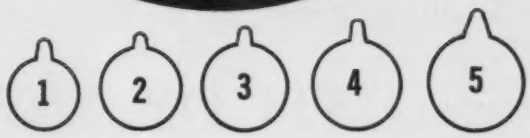

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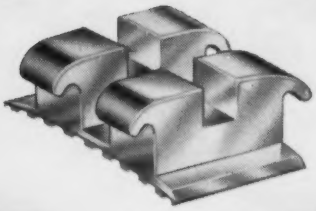

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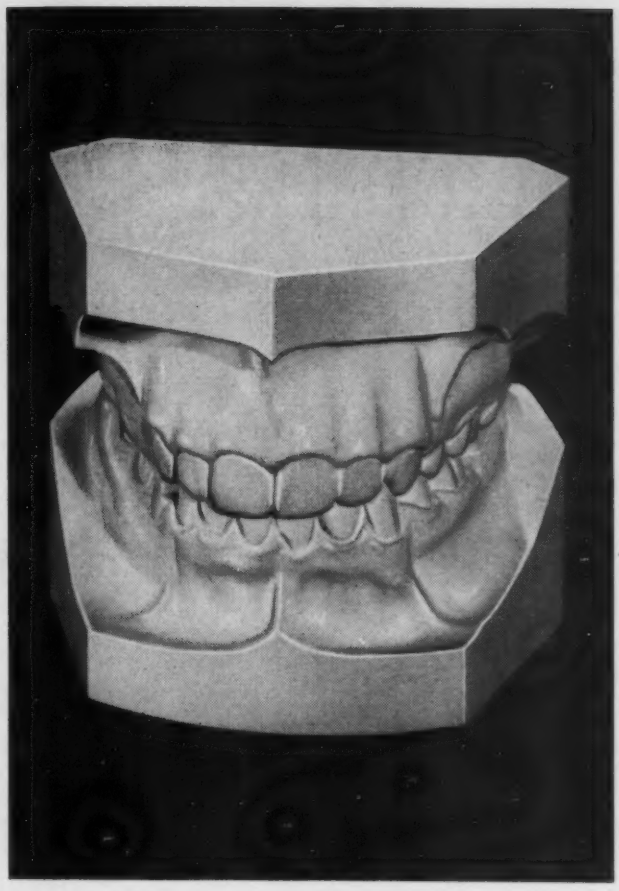

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